70

843
N. M.

Published monthly by the

University of the State of New York

BULLETIN 323 OCTOBER 1904

New York State Museum

Ephraim Porter Felt State Entomologist

Bulletin 79

ENTOMOLOGY 22

MOSQUITOS OR CULICIDAE OF NEW YORK STATE

ALBANY

NEW YORK STATE EDUCATION DEPARTMENT

1904

Me113m-Ap4-2500

Price 40 cents

STATE OF NEW YORK

EDUCATION DEPARTMENT

University of the State of New York

New York State Museum

Bulletin 79

ENTOMOLOGY 22

MOSQUITOS OR CULICIDAE

OF

NEW YORK STATE

PREFACE

Large scale operations have demonstrated the practicability of the apparently impossible, and many formerly pest ridden areas are nearly free from mosquitos as a result of well directed exterminative work. This publication calls attention to the more important species, the number of forms which occur in the State, the advisability of studying them closely in order to devise improved methods of controlling the pests, and gives keys and illustrations for their identification. It will be seen by reference to the following pages, that the term mosquito includes a great many forms, and it requires no argument to prove the advisability not only of knowing the species we are obliged to fight, but also their habits, in order that the work may be carried on most intelligently. Such information should also prove of service to nature teachers, since no group of insects is more easily obtained or lends itself more readily to classroom conditions.

This bulletin summarizes our knowledge to date and places on record the results of such studies as we have been able to make during the past few years. No attempt has been made to revise the generic grouping or to determine the synonymy of the species. Special attention has been given to establishing the identity of larvae and adults by isolated rearings and when in doubt as to

specific identity, we prefer to describe and risk creating a synonym rather than confuse two species. We have studied, in the course of this work, specimens of over 40 species, rearing from larvae both sexes of most forms.

The writer acknowledges the earnest cooperation of his assistant, Mr D. B. Young, who has not only done much of the field work, but has determined many of the species and prepared the tables for separating the adults.

Mr C. M. Walker did considerable field work and breeding in 1903. Most of the determinations have been kindly reviewed through the courtesy of Dr L. O. Howard, by Mr D. W. Coquillett, of the United States National Museum. Due acknowledgment should also be made to Dr H. G. Dyar of the same institution, who generously donated a number of larvae and adult mosquitos from which certain illustrations were made.

E. P. Felt

Albany N. Y. March 1904

MOSQUITOS OR CULICIDAE OF NEW YORK

INTRODUCTION

Mosquitos, individually and collectively, have long forced themselves on the attention of mankind, but it is only within recent years that they have received careful scientific study and that the practicability of abating the annoyance and injury caused by them has been demonstrated. The discoveries that certain species conveyed malaria and yellow fever aroused great interest in this group. This is well illustrated by what we knew a few years ago compared with the present time. Our leading dipterist in 1878, published a list containing 33 species, which represented all that were then known to occur in North America; and only three years ago Dr Howard stated that there were about 24 species in the United States. Today over 50 have been found in New York or adjacent states, the latter under conditions which lead us to believe that they also exist within our boundaries. It is very likely that the total number of mosquitos in North America, is treble that known 25 years ago. A monograph of the mosquitos of the world published in 1901, by F. V. Theobald, lists 343 species, and within two years, owing to active collecting and study by scientists all over the world, a third volume has been issued, describing 88 additional species, making a total of over 430. It is very probable that since this volume was published, at least 20 new forms have been characterized. It would not surprise us, if within a year or two this list of species of the entire world, of an heretofore inconspicuous group, closely approached the 500 mark.

The excellent work of the North Shore Improvement Association, and that of such villages as Lawrence, L. I., South Orange and others in New Jersey have demonstrated the practicability of keeping the mosquito pest in subjection. This practical work has concerned itself not only with disease-carrying species, but it has sought to lessen the hordes of those annoying to man, both materially depreciating the value of real estate, particularly in the vicinity of New York city. The magnitude of this

evil can be appreciated only by those conversant with the situation. It is surprising, though nevertheless true, that there are practically 200 (199.15) square miles of swamp land within 25 miles of New York City Hall. Nearly 100 (95.55) square miles of this salt marsh are within the boundaries of New York State, and very little (1.75 sq. m.) fresh water. New Jersey has over 100 square miles (101.85), 41.4 being fresh water swamps. The proximity of this entire area to New York city makes it of considerable importance, particularly as portions produce billions of annoying pestiferous insects, which have a detrimental influence on the value of adjacent highlands. Certain of these insects are a serious menace to public health, and swarms of the others are nearly unendurable nuisances.

The extended areas favorable to the production of mosquitos, and the fact that not all marshes lend themselves kindly to political boundaries, make it difficult to devise practical methods of checking the evil. The work so far done about New York has been performed under considerable disadvantages. On account of the lack of funds, it has been impossible for local associations to give proper attention to the scientific aspects of the case and at the same time carry on the extensive field operations necessary. Experience in other lines of applied entomology has demonstrated time and again not only the advisability but the necessity from an economic standpoint of basing practical work on scientific investigations. No one thinks of employing an architect to superintend the construction of a dry-goods box, and yet the man who undertook to erect one of the modern large buildings without such skill at his command would be engaged in a foolish undertaking. In the same way, it requires little scientific knowledge to drain a small swamp or kill a few mosquitos, particularly if they belong to only one or two species. It is entirely different when we undertake to apply this process to large areas, possessing considerable diversity and possibly lying in different sections of the State. This can be done to advantage only after extended studies have demonstrated the advisability of certain courses for the control of various species under different conditions. The

time and money expended by a specialist in solving these preliminary problems are exceedingly well invested, and the saving resulting from his services should pay for the cost of his work many times over.

It must not be assumed that we know all about mosquitos. Much valuable work has already been done, but there is great need in this State of a general biologic survey of the more important swamp areas, particularly those about large cities, for the purpose of determining the places most prolific of mosquitos, the species which occur there, and the times when they are most likely to appear. The effect of climate and other conditions on the abundance of these insects should be carefully studied, since there is considerable variation in this respect. The number of kinds of mosquitos occurring in different areas should be determined, and their habits, powers of flight, etc. carefully ascertained. There is great divergence in this respect among the different species, and knowledge of this is of utmost importance in all practical efforts looking to their subjection. These fundamental facts acquired, we are in position to determine by experiment the best method of solving the problem under various conditions. Every effort should be made to find solutions which will result in the increased value of swamp lands, paying very largely or entirely for the improvement; in other words, aim wherever possible to make permanent betterments which will pay for themselves and incidentally solve the mosquito problem. The extensive swamp areas about New York city, if reclaimed, would possess considerable value either for market garden purposes, or, in the course of time, as residential sites.

Mosquitos as carriers of disease. A number of years ago it was demonstrated that filariasis or elephantiasis was conveyed by the bite of certain mosquitos, and more recent investigations have shown that both malaria and yellow fever are disseminated in the same manner. In fact, it is very probable that these diseases of man can be spread in no other way, and there is a possibility that others of a similar character may pass a portion of their life in and depend for transmission on members of this exceedingly interesting and important group.

Malaria. This disease is by far the most important of the above named in New York State. Professor Herrick, in a recent paper, concludes that "malaria is responsible for more sickness among the white population of the South, than any disease to which it is now subject." It is less important in New York, yet this enervating disease is certainly responsible for large annual losses, because all those infected are frequently unfitted for work, though comparatively few deaths are attributed directly to it. It is conveyed, as shown by various investigators, by members of the genus Anopheles, of which we have three species, A. crucians, A. maculipennis and A. punctipennis, the latter two are probably agents in its distribution. These insects act only as intermediary hosts, affording the parasite which produces the fever, favorable conditions for undergoing certain changes prior to its introduction into the human system. It is impossible for these mosquitos to convey malaria before they have become infected by biting a malarious subject, and consequently the spread of this disease is readily checked by either destroying all of the insects capable of carrying it, or by keeping them from sources of infection. Anopheles must exist where malaria occurs, though it does not follow that the distribution of malaria is coincident with that of Anopheles.

Yellow fever. This dread disease of man is well known, and up to within very recent years no adequate knowledge existed as to the way in which it was spread. Dr Josiah C. Nott, of Mobile Ala., published in the *New Orleans Medical and Surgical Journal* for March 1848, a number of reasons why insects probably were agents in carrying this disease. This was again advocated in 1881 to 1886 by Dr Finlay of Havana, and recent investigations in Cuba demonstrated that it may be carried by a mosquito, Stegomyia fasciata, and possibly by some other forms belonging to the same genus. As in the case with malaria, the yellow fever mosquito is simply what is known as an intermediary host and must first become infected with the parasite before it is capable of imparting this dangerous disease. Control of these pests is so important in Cuba that the general government spent about

$100,000 in their destruction the year after it was proved that mosquitos conveyed the fever, eminently satisfactory results being obtained.

Filariasis. This dread disease is limited to the tropics, and while horrible in its effects, is of much less importance in New York State, and consequently is only mentioned.

It has been demonstrated that certain mosquitos convey malarious parasites to birds, and it would not be surprising if future investigations should show that some species were guilty of harboring other diseases than those named above.

Distribution and abundance of mosquitos. These frail insects are ordinarily regarded as inhabitants of temperate or warmer climates, yet it is a fact that certain species exist in hordes even within the arctic circle. Entomologic literature contains many records of enormous swarms of these insects, and in some cases they are carried miles by the wind, and are so bloodthirsty as to drive man and beast before them. These insects are so aggressive in some localities as to give name to a place; for example, there is a town named Mosquito in Illinois, a village bearing the same title in Newfoundland, a Mosquito creek in Indiana, another in Iowa, still another in Ohio, and most of us have heard of the mosquito country of Central America. Dr Riley states that the bravest man on the fleetest horse dares not to cross some of the more rank and dark prairies of Minnesota in June, while the marshlands of New Jersey and the hills of Long Island have become notorious because of the abundance of these little pests, and frequenters of the Adirondacks can speak from experience of the biting powers of these insects.

Adults. Adult mosquitos vary in habit, many, as we know, flying at dusk, some almost all night, and a few may be found abroad in the daytime. The normal food of adult mosquitos is probably plant juices, and the taste for blood possessed by certain species is presumably an acquired habit. Blood-sucking mosquitos not only attack mammals, but also birds, reptiles and fish, even killing the latter in some cases. Members of certain genera, according to Theobald, are not bloodsuckers. Aedes, in

the restricted sense, rarely attacks men or animals, while Sayomyia and Corethra feed exclusively on vegetation. These latter two are said to inhabit the open country and do not enter human habitations. Certain species pass the winter as adults, and all as a rule, fly relatively short distances. Notable exceptions to this are Culex sollicitans and C. cantator. Very few mosquitos are met with in the daytime because they are usually hiding in dark crevices about houses and other shelters, or have taken refuge among foliage or near the base of grasses. These insects are very susceptible to climatic changes, though we believe that the frequently noted appearance of large numbers just after rains is due more to the multiplicity of favorable breeding places, than the necessity of moisture for the welfare of the adult. Heat favors rapid transformations, and this may hasten the disclosure of unusually large numbers of the pests.

Migration of flight. The migratory habits of mosquitos have a very important bearing on repressive measures, because if the insects are capable of flying long distances it means that considerable areas must be treated in order to secure immunity from the pests. Extended experience and observation, not only in this but other countries, have shown that the malarial mosquitos, Anopheles, are very restricted in their habits, flying only 200 to 300 yards, and consequently that local work is exceedingly effective in reducing their numbers. The same is probably true of our house mosquito, Culex pipiens, and to a less extent of a number of other species. This is not the case with the salt marsh mosquito, Culex sollicitans and its associate, C. cantator, both of which, as demonstrated by Dr Smith, are capable of flying or drifting with the wind to a distance of 40 miles or thereabouts. His observations were limited to New Jersey, and we have yet to learn of equally prolonged flights in New York State, though data at hand and observations indicate that this species may easily fly or drift several miles. The practical work conducted in the vicinity of New York city indicates that a large amount of freedom, even from these two species, may be secured by work restricted to comparatively limited areas, and as a rule local

effort, even in the case of these two species, will afford considerable relief, which is certainly true of others liable to become at all troublesome. A number of instances have been placed on record in recent years, proving the efficacy of operations confined to small areas, and further investigations may show that the migrations observed by Dr Smith were somewhat local and brought about by peculiar conditions. Mr G. C. Davis has recently published data showing that mosquitos in arid portions of California are carried over 20 miles by steady, gentle breezes. Railroad trains have been suggested as an efficient means of disseminating mosquitos, but Dr Smith's observations, showing that while a train might become filled with mosquitos while passing through an infested marsh, it was practically free when the haunts of the mosquitos were left behind, would seem to indicate that this method of transportation is of relatively small importance. Railroad trains might, however, convey small numbers to favorable breeding places, where the insects would be able to survive for a few generations, and in this way centers might become established. Ships are probably very efficient in conveying species from one country to another, since Rowe has observed 12 foreign species on a ship in quarantine at New York.

Life history. Only a few years ago it was supposed that the life histories of most species of mosquitos were substantially identical. The great impetus given to the study of this group by the recent demonstration that certain forms were capable of conveying malaria and yellow fever, has practically disproved this notion, and now we know that there is considerable variation in their life histories and habits, as will be seen by reference to accounts of different species on the following pages.

Hibernation. At one time it was presumed that the winter was passed solely by the adults, and while this is undoubtedly true of certain species, others hibernate in the egg stage and still others as larvae and possibly pupae. Several observers have noted the resistance of larvae of this insect to cold and have placed on record instances where they have been frozen repeatedly and survived.

Eggs. Dr Dyar has made a somewhat extensive study of the oviposition habits of various mosquitos, and has ascertained in the case of the species studied, that those with unbanded legs produce eggs which float on the surface, some in masses, as for example, C. pipiens, while in others they may be deposited singly or in small groups of two or three. The ring-legged species deposit their eggs, like C. sollicitans for example, in dry places where water is likely to collect, a portion hatching after a wetting, so that a series of swarms are produced by high tides and storms from the overwintering eggs. C. canadensis deposits its eggs singly and many sink to the bottom, most of them remaining unhatched till the following spring. C. sylvestris lays its eggs in a similar manner, and the species breeds continuously throughout the season, practically all eggs hatching when covered by water, except possibly those laid in September, which, in the instance under observation, hibernated.

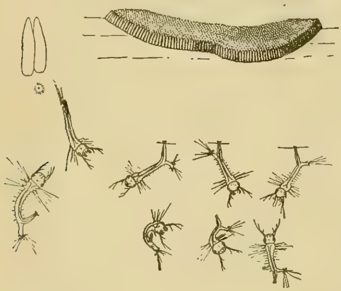


Fig. 1 Culex pipiens. Egg mass, with enlarged eggs at left and young larvae. (Reduced from Howard. U. S. Dep't Agric. Div. Ent. Bul. 25, n. s. 1900)

Larvae. Mosquito larvae, as a rule, subsist mostly on decaying vegetable matter and algae, though they are also carnivorous in habit, and species of Corethra and Sayomyia entirely so. Certain species have decided preferences in breeding places, some being found only in or near brackish or salt water, others only in fresh water, a few in foul water, some in warm, fresh water, while others prefer cool spring-fed pools and similar places. Dr Dyar observes that larvae with a short air tube are generally found in temporary pools, while those with a long air tube occur in permanent waters. Small fish feed on the larvae so readily, that they are very rarely found where these enemies occur, and consequently practically all breeding is limited to fishless waters, except in the case of some of the more transparent forms like Sayomyia.

Pupae. Pupae of most mosquitos are very similar, active and floating at the surface of the water. This stage is usually short, its duration being greatly modified by the temperature.

Methods of collecting and breeding. Mosquitos are readily captured with a dexterous sweep of the hand, and by exercising a little caution the body will be only slightly crushed and the specimen, therefore, not ruined for identification. They may also be taken by deftly slipping a small cyanid bottle or one containing a little cotton soaked with chloroform over the insect while it is at rest on a wall or person, or inside an insect net, if the latter be used. The fumes of the cyanid or chloroform kill the insects quickly, and they can then be easily transmitted in small vials between lightly placed wads or layers of cotton. The species occurring in and about houses are of special importance.

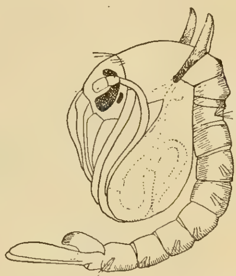


Fig. 2 Culex pipiens. Pupa, enlarged. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 25, n. s. 1900)

Some of the rare forms and perfect individuals of most species can be obtained as easily by collecting the larvae as in any other way. The latter may be found in pools of almost any character where fish do not occur, and sometimes in small numbers even when these enemies are present. Mosquitos have decided preferences in breeding places, and various species may be found under widely different conditions. An examination of almost any small body of water should reveal specimens sometime during the season. A definite idea of breeding places of different species, may be gained by reference to the accounts of various forms. Larvae may be taken by the use of a fine meshed coffee strainer, and if a small porcelain dish or one lined with white enamel is used for the reception of the catch, it will be much easier to detect them. They may be kept alive several hours in small vials partly filled with water, or they may be killed at once by transferring them to 50% alcohol, which is strong enough to preserve them for several days, after which they should be placed in 75 to 85% alcohol. Both

larvae and adults may be shipped safely in vials by mail, provided they are packed in a little cotton and inclosed in a stout box.

The life cycle of the mosquito is so short, and the different species so easily reared, that there is little difficulty in obtaining adults from either eggs, larvae or pupae, particularly the latter. Soil gathered in wet places in the spring is very likely to produce larvae, provided it be kept covered with an inch or more of water, and with moderate attention the young should develop to adults without trouble, though it is advisable to imitate natural conditions so far as convenient. Young larvae are usually easily reared, and as they approach maturity there is less danger of death by disease or from insufficient food. Careful breeding work necessitates the isolation of individuals and the preservation of the larval skin with the adult, since it is very easy to confuse species in the larval stage, specially when it is remembered that we have taken larvae belonging to seven species from the same pool and at practically the same time. There is great need of this kind of work, and it is hoped that many will undertake it in the near future, and thus make material additions to our knowledge of the mosquitos of New York State.

Examples of either adults or larvae, together with records of the conditions under which they were taken, will be welcome, and the entomologist will gladly reciprocate by giving advice in individual cases, and specially interesting localities may be closely investigated.

Haunts and breeding places. The haunts and breeding places of mosquitos are of prime importance to one attempting to control the pest, and therefore considerable space will be given to this phase of the subject. We may divide mosquitos in a general way into semidomestic and wild species, the former occurring more or less in the vicinity of dwellings and frequently entering them, while the latter rarely have this habit.

Anopheles. The members of this genus are of great importance in New York State, because of their malarial carrying powers. The adults are frequently found in the vicinity of dwellings, and

investigations in September 1902, in the city of Albany, showed that it was comparatively easy to find specimens of Anopheles punctipennis in many of the area ways in different sections of the city. It was observed that the insects were more abundant in the areas where there was only a doorway and consequently poor ventilation. Mosquitos evidently do not like a draft, and in most places where there was a free circulation of air comparatively few were to be found. In view of this fact some relief from

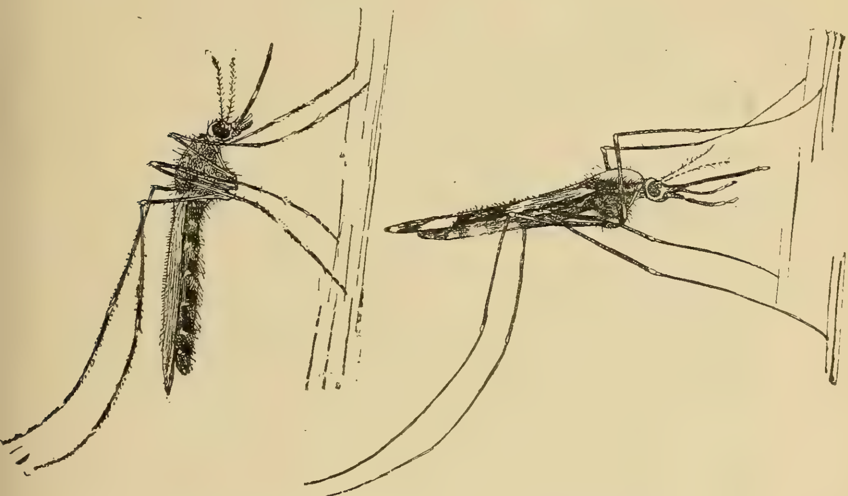


Fig. 3 Resting positions of Culex at left and Anopheles at right. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 25, n. s. 1900)

mosquitos, particularly Anopheles, might be obtained by providing free ventilation in area ways and other sheltered places like porches, so that mosquitos would be disinclined to take refuge therein. As is well known, these insects may also be found in outbuildings of various kinds, in fact in almost any dry place where there is not too much air. They fly throughout the summer and we have met with specimens on snow in the middle of March.

The natural breeding places of Anopheles larvae, according to Dr Howard, are in the more or less permanent pools of water such as are found in the bed of an old canal in spring, in wood-

land streams, or in the side pools or shallows of field springs or artificial excavations filled with water. Small larvae are to be found in such places, particularly where there is a certain amount of green scum. Nuttall and Shipley state that in England these larvae are to be found in pools, ditches, backwaters of rivers and

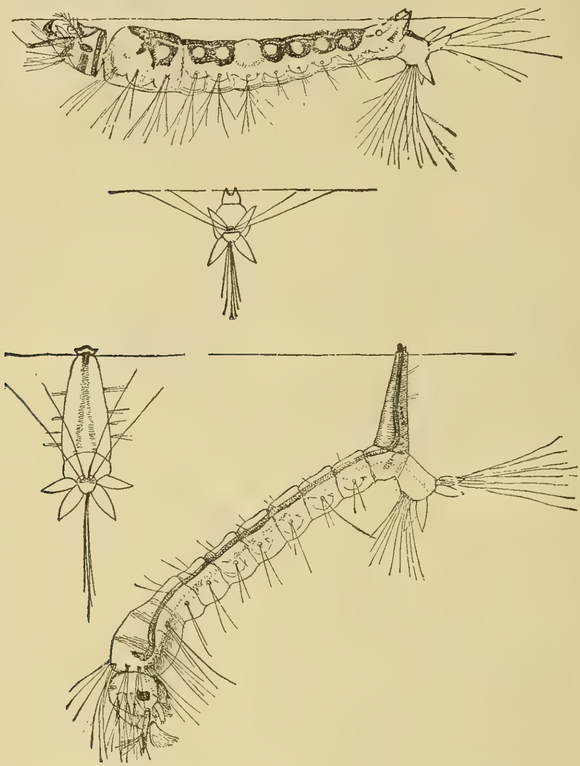


Fig. 4 Characteristic feeding position of Anopheles larva in upper figure, and that of Culex in lower figure. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 25, n. s. 1900)

canals and in other slow flowing waters, almost invariably in such as are clear, and very rarely in impure or brackish water. They state that the larvae frequent places not shaded by trees, though Dr Howard has found them on several occasions in dense shade. He adds that they are rarely found in water contained in barrels, troughs and fountain basins. Our own experience has been somewhat different, in that we have had no difficulty in obtaining larvae of Anopheles in rain water collected in an old

paint pot and in association with Culex. We have also taken numbers from a barrel containing spring water, where there was considerable algae or green scum, while we failed to find specimens in a large spring within 150 feet, though there was much algae at the sides. We have also taken them beside a stream in a depression among the rocks, where there was considerable algae, a single specimen was met with in a barrel of filthy water, and we have found them abundant in weedy, semistagnant pools beside watercourses.

Culex pipiens and other semidomesticated species. The adults of these species have somewhat similar habits to those of Anopheles, and like them were found by us in unventilated area ways in different sections of Albany. It is probable, as pointed out above, that ventilation would result in many of these mosquitos avoiding such retreats. The larvae, as is well known, are found in multitudes in pails and barrels of standing water, and wherever there are holes in the earth, tin cans and other debris holding water we may expect to find larger or smaller colonies of these insects. Cisterns supposed to be tight frequently produce thousands of mosquitos, and they have been detected emerging in considerable numbers from sewers. Gutters with deficient fall may harbor millions, and almost any standing water in the vicinity of a house is likely to produce these insects; one can not look too closely for breeding places.

Salt marsh and other wild mosquitos. The salt marsh mosquito and its ally, C. cantator, are the two most important of our wild forms and the ones which cause the most annoyance in the vicinity of seacoasts. These two species breed on the salt marshes, preferably in brackish water, and the work of several investigators has shown that only limited portions of the marshes produce the pest. It has been repeatedly observed after high tides, that the salt marshes along the upland and extending out a distance of 150 to 250 feet, were swarming with larvae. They are largely protected in these places from spraying operations by grass, and it is impossible for fish to get at them. These species breed principally in pools at the head of the marshes to

which tides rise only occasionally and in which the water is quite brackish. Here the wrigglers have time to develop before the tide again visits the pools, sweeping away their contents. As a rule none are found in pools not reached by tides or in those containing fish, neither are they found where killifish occur nor in association with fiddler crabs. It will be observed that the breeding places of these two species are confined to limited areas, and consequently, while their control may at first sight appear to be a gigantic undertaking, in reality it is largely simplified by these restrictions.

Other wild species have more or less decided preferences as to breeding grounds, the details of which are given under accounts of the different species. These forms, as a rule, are of minor economic importance, though their habits, as well as those of more annoying mosquitos, should be carefully investigated.

Natural enemies. Small fish are by far the most important among the natural enemies of mosquitos, and the introduction of suitable forms into fishless waters sometimes affords one of the readiest methods of controlling these pests. Almost all of the small carnivorous fish which inhabit swamp pools and still water will feed on mosquito larvae. This includes nearly all of the minnows, particularly those known as top-minnows. The little sticklebacks are very efficient in this respect. The common little sunfish or "pumpkin seed" is also recommended as a voracious devourer of mosquitos, and it has the advantage of the preceding forms, in that its spined rays protect it from some of the larger fish. The common goldfish has also been reported as an important ally in controlling mosquitos. Tadpoles may eat mosquito larvae, though there appears to be some doubt on this point, and as we have observed larvae in association with tadpoles, they can not be voracious devourers of wrigglers. Mr Koebele of Hawaii has observed a salamander devouring larvae.

A number of aquatic insects, such as dragon fly larvae, the young of predatory water beetles and various aquatic bugs feed on mosquito larvae and are undoubtedly valuable aids in controlling this pest, though hardly forms which could be handled and bred or distributed in the same way as fish.

Adult mosquitos are fed on by a number of natural enemies, prominent among which may be listed various birds and bats. Theobald mentions the night hawk, swallows, martins and fly-catchers as being specially valuable. It is well known that dragon flies devour many small flies, including mosquitos, and Dr Howard records, on the authority of Mr E. P. Salmon of Beloit Wis., the presence of a little red louse on mosquitos. Attack by some mite, probably Trombidium muscarum, on mosquitos has also been reported to us by Mr J. G. Lindsley of Oswego N. Y., an observer in whom we have utmost confidence.

Adult mosquitos are also attacked by certain fungus diseases. First, Entomophthora spaerosperma Fersn., attacks many different insects and frequently affects mosquitos. Another species, Empusa culicis Braun., is very similar to the fungus so frequently observed on house flies, and is one, as the name implies, that destroys many of these little pests. A third species recorded by Thaxter as attacking small gnats is known as Empusa papilata, but as the gnats were not determined we can not say that it affects mosquitos. In addition, Prof. R. H. Pettit of Michigan, records attack on mosquitos by a new species of Entomophthora. He states that on Aug. 5 Mr Barlow found a number of adult mosquitos killed by it, and that they were very numerous on the margin of one of the pools in the North Woods, sometimes almost covering the soil and the pieces of bark to which they clung. Recently killed individuals, showed little, if any, external growth, while others were covered with a dull white coat and all were within a few inches of the water and headed away from it. The victims die so close to the water, that they are, as pointed out by Professor Pettit, in an ideal situation to infect their fellows. He states that the appearance of an infected mosquito is very characteristic. The entire body is swollen and covered with a dull white growth, sometimes almost lead color, and it is fastened down by many slender brownish threads. This fungus was also met with by him on several species of Muscidae, on a Chironomid and on a dragon fly, probably Diplax rubicundula. Several attempts were made to introduce the disease in other places, but without success.

Methods of control. Mosquitos have been tolerated from time immemorial. It was a supposed impossibility to do more than to exclude the little pests from dwellings. Abating such a nuisance appears to be a herculean task at first sight, but study and experience have demonstrated that it is eminently practical to reduce the numbers of these insects very materially. There are two important phases to this problem: one, the destruction of domestic species which enter our houses, certain forms of which are capable of conveying malaria to their victims, and the annihilation of the many swarms bred along seashores and other places more or less remote from the habitations of man. These two problems have this in common, that they aim to destroy insects, but the methods of accomplishing the desired end in one case is quite different from that in the other.

Destruction of semidomestic species. The semidomestic species include such forms as Anopheles, Culex pipiens and a few other house species. These insects possess limited powers of flight, and as a consequence those troublesome about a house are bred near by, in many cases within 200 yards, and sometimes within 25 feet of the dwelling. Our main object in the fight against these species is to abolish favorable breeding places in the immediate vicinity. This means that a most careful watch must be kept for uncovered rain barrels, partly open cisterns and cesspools or near-by hollows which may hold water for a short time, broken crockery, tin cans and any other debris, which may afford the necessary conditions for the existence of larvae. Such a campaign calls for the minutest scrutiny of all likely and even unlikely places, to see that they do not supply conditions favorable for developing mosquitos. Drainage has a prominent part. particularly in low places, because we know of instances where houses cover standing water, but in the State at large this is hardly true, and fair drainage prevails. The appearance of considerable numbers of these mosquitos about a dwelling is almost proof that there is a breeding place in the immediate vicinity, and the owner, if he objects to the pests, can do no better than to search for and do away with them in some way or another, either

by drainage, sealing, supplying small fish which will feed on the wrigglers, in case this is possible, or treating the surface with kerosene or other oil.

It will usually be necessary to supplement the above measures by carefully screening dwellings, so as to exclude the few remaining insects. This is particularly important in the case of Anopheles, because of its disease-carrying possibilities. Living mosquitos may be stupefied in closed rooms by burning pyrethrum powder, which should be moistened somewhat and molded into little cones and then dried in the oven. These cones may be lighted at the tip and will then smolder slowly, filling the room with a not unpleasant smoke which appears to stupefy the mosquitos. It is said that two or three of these cones will give relief during the entire evening, provided the windows are closed. Dr Howard also calls attention to the modification of a device frequently used for catching house flies. It is nothing more than a tin cup or inverted can cover nailed to a stick and containing a small quantity of kerosene. It is pushed up under a mosquito resting on the ceiling, and as the insect attempts to fly it is caught by the oil and destroyed. Such a device would be very convenient if used in the early evening, to rid sleeping chambers of the pests.

Salt marsh and other wild mosquitos. Mosquitos belonging to this group are usually troublesome only in the vicinity of the seashore, and the common salt marsh mosquito, Culex sollicitans, is by all odds the most serious pest of them all. Acquaintance with its breeding habits has taught us that the larvae occur usually within 100 to 250 feet of the shore, and that they develop largely in places reached only by the higher tides, numbers of eggs hatching after each high tide or heavy rain, thus providing a series of swarms throughout the season. The obvious thing is to either so ditch and drain that no pools will remain after the retreat of high tides, or else by a series of dikes exclude the tides and in this way render large tracts unsuitable for breeding purposes. Extensive areas can be treated in this way, and if diking is followed by proper drainage and reclamation, many acres of land exceedingly valuable for agricultural pur-

poses, or which might be used for suburban residences, could be placed on the market. There are many depressions in salt and other marshes and also on dry land which can be readily transformed from pernicious breeding places to harmless soil by a little filling. Ditching, digging and filling may be regarded as permanent methods of doing away with the mosquito nuisance. This is not always possible, and it is then necessary to resort to temporary measures, such as spraying breeding places with petroleum, in order to destroy the larvae. The succession in the hatching of the eggs of the salt marsh mosquito, and the several generations produced by Culex pipiens in fresh waters, render the repetition of this petrolizing or treatment with oil necessary at more or less regular intervals throughout the breeding season. It is more costly in the long run than the more permanent measures and can be recommended only as a temporary expedient.

The natural enemies of mosquitos are of considerable value in this warfare, and this is particularly true of the small fish mentioned in a preceding paragraph. It not infrequently happens that a fresh or salt water pool affords ideal conditions for the production of millions of mosquitos, a state of affairs that can be easily remedied by the introduction of some of these fish. They may be brought from some distance in the case of isolated pools, but there are many easily connected with fish-inhabited bodies, where even this would not be necessary.

CULICIDAE

Mosquitos are so familiar to most people that a scientific definition of them hardly seems necessary. The most characteristic feature of the adult is the presence of hairlike scales along the veins and margins of the wings. The females of our common species are easily recognized by their hum and bite, while the innoxious males, rarely seen in nature, have conspicuous feathery or plumose antennae.

These small insects may be separated from closely allied flies by the long, slender abdomen, narrow wings, the plumose an-

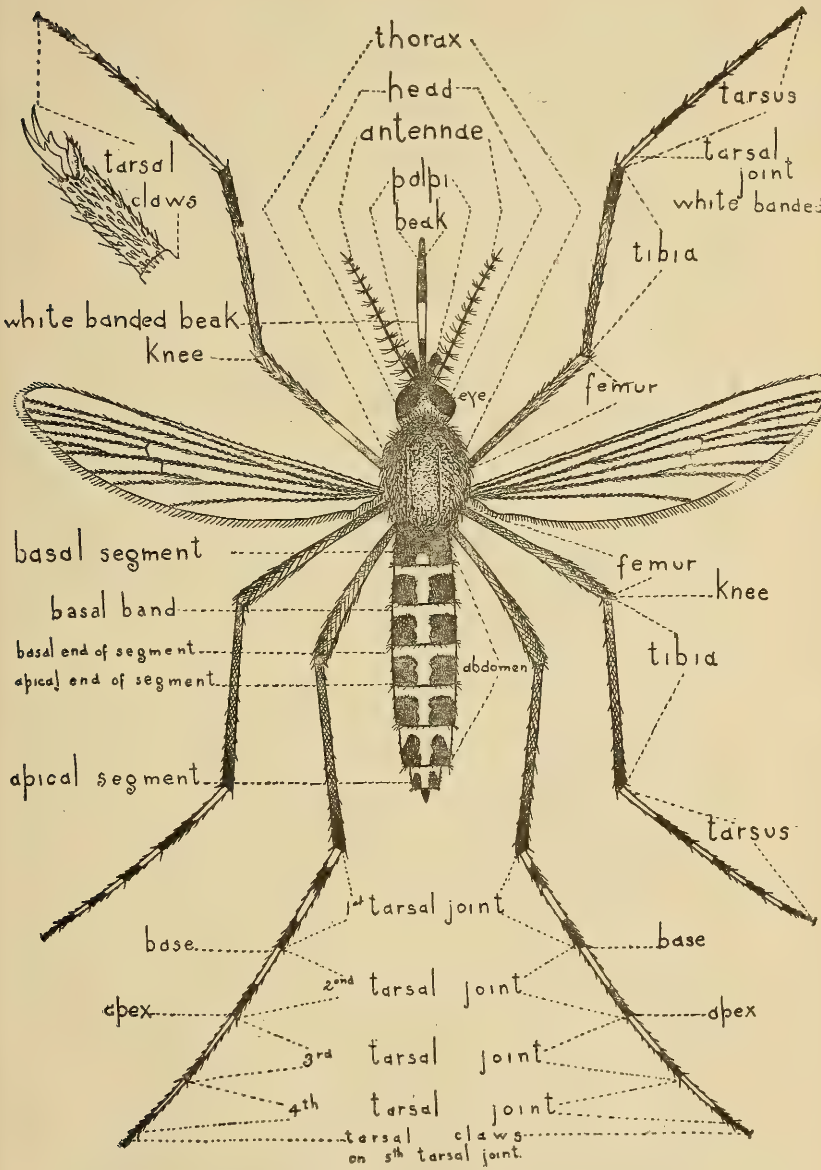


Fig. 5 Mosquito showing parts used in classification (After Smith, N. J. Agric. Exp. Sta. Bul. 171. 1904)

tennae of the male and the usually long, slender proboscis of the female. The thorax lacks the transverse V-shaped suture seen in the crane flies, and the most distinct feature, as stated above, is the scalelike hairs on the wings, specially the margins. The larvae of all species, so far as known, are aquatic in spite of the fact that adults have been observed in arid regions far from water.

The characters of greatest service in studying mosquitos, are so plainly shown in figure 5, that no detailed explanation is necessary. It may be well to call attention a little more in detail to the wing structure of this group, which is very interesting not so much on account of variations in the veins as in the structure and distribution of the scales. The more important wing veins may be easily recognized by running back from the costa as follows: subcosta, first longitudinal, second longitudinal, third longitudinal, fourth longitudinal, fifth longitudinal and sixth longitudinal, the second and fourth longitudinal veins having the characteristic fork cells, that of the former frequently being termed the first submarginal cell. These two veins are connected by an important cross vein known as the anterior cross vein. It may be easily recognized because it is intercepted near the middle by the third longitudinal vein. The posterior cross vein connects the fourth longitudinal and the anterior branch of the fifth longitudinal veins. The relative distance between these two cross veins and the relative length of the petioles and their fork cells is of considerable service in classification. The male wing may be recognized by the much longer petioles, sparse scales and the absence of oblique scales along the greater portion of the posterior margin. The scales of Culicids vary exceedingly, ranging from almost linear in Corethra and Sayomyia to the lanceolate ones of Anopheles or the very much dilated scales of Uranotaenia. The latter is remarkable for the diverse structure of its wing scales. The genus Culex presents very interesting variations in wing scales. Generally speaking there are two classes—the long and the short, the longer ones being slender, frequently strap-shaped and as a rule extending some distance on each side of the veins, while the short scales are more or less

broadly triangular and usually closely appressed to the vein. The scales of the fringe also present important characters. Usually a row of long and another of medium scales constitutes the fringe proper, though in the females of the Pipiens group the fringe scales form three or four rows of different length [pl. 26, fig. 2]. In addition, there is a row of short, oblique scales along the greater portion of the posterior margin in the females, which is usually absent in the males along the inner two thirds or four fifths. The different characters of the wings of the various species are so well shown on the plates that no further description is necessary.

The accessory male genital organs, as pointed out by Professor Theobald, possess specific value, and in the case of the species studied by us, present most remarkable variations as will be seen by reference to illustrations on plates 29–40. As an aid to identification a tabulated statement of the differences follows. It is practically a key to the males studied and supplementary thereto we give a brief explanation of the terms employed. The more conspicuous lateral organs have been termed the clasps; these are composed of two segments: a large basal one, which presents considerable modification in form, and bears, particularly in the Pipiens group, very characteristic appendages near the apical third, and near the base more or less peculiar chitinous spines in a number of species. The terminal segment of the clasp is more slender and, in some species, bears at its apex two apical teeth, while others possess a more or less developed spine, apparently a rudimentary third segment. The harpes, lying just within the clasps and originating near their base, are normally next in size to these important organs and may usually be recognized by the pronounced angle frequently present near the more or less perfect fusion of two segments. These organs are remarkably diverse in structure and presumably occur in all species, though in certain forms, owing to lack of material, we have been unable to detect them. The harpagones are paired, smaller, clasping organs, usually strongly curved and terminated by a stout, somewhat recurved hook. The

unci, as we have identified them, consist of a pair of usually fused processes on the ventral margin, which present considerable variations in structure. In addition, there is frequently present anterior to the unci, a pair of peculiar, rudimentary, spine-tipped organs, which apparently belong to the preceding segment, and for the purpose of identification they have been termed appendages of the eighth abdominal segment. Lack of material has prevented working out thoroughly the homologies of these organs.

It may be well in this connection to call attention briefly to some of the more important characteristics of mosquito larvae. The antennae vary somewhat in form and coloration, and particularly in the position and size of the antennal tuft [fig. 64]. The labial plate presents characteristic variations in certain species [fig. 12, 44]. The more important characters, however, are found in the air tube, its form and relative length and in the rows of posterior pecten or teeth at its base [fig. 21, 45]. There is wide variation in the number of teeth, their serrations, degree of development [fig. 22, 40], and within certain limits considerable constancy obtains. There is also an interesting patch of scales or spinelike scales on each side of the eighth abdominal segment, which for the sake of brevity has been termed the comb. The size of this patch varies considerably and there are marked differences between the various species in the number and structure of the component scales [fig. 13, 28, 48] and in our experience there is a much greater constancy in the number of comb scales than has been recorded by some. In the interests of clearness and brevity the term pecten has been limited to the structures occurring on the air tube, while the component members of the comb are designated as scales. Several characters of less general importance are mentioned in treating of the various species.

Key to subfamilies

a Proboscis long, formed for piercing; palpi long in both sexes; wings usually spotted .... Anophelinae

b Palpi short in female; wings not usually spotted .... Culicinae

bb Palpi short in both sexes .... Aedeomyinae

aa Proboscis short, not formed for piercing .... Corethrinae

Culicid genitalia

SPECIES	CLASPS: Second segment	CLASPS: Basal segment	HARPES	HARPAGONES	UNCI	APPENDAGE OF EIGHTH SEGMENT
Psorophora ciliata	Irregular, setose, 2 apical spines	Subconic	Strongly curved, irregular, furcate, inner branch setose, outer falcate	Curved, with stout apical hook	Curved, with stout apical hook	
Anopheles punctipennis	Slender, curved, small apical spur	Subcylindric, with 2 very long, straight basal spines	...	...	Narrow, fused, furcate	
A. maculipennis	Slender, curved, small apical spur	Subconical, with 2 long, curved basal spines	...	...	Narrow, fused	
Culex sylvestris	Stout, expanding, furcate, inner apex with stout tooth	Stout, curved, with internal basal tufts	Cylindric, short, setose apically	Slender, nearly straight, spined apically	Curved, slender, platelike	Papillate, rudimentary
C. cantans	Slender, flattened, strongly curved, with long apical spur	Dorsal lobe apically, a stout, curved basal spine	Flattened, strongly curved, apical portion falcate	Curved, with stout apical tooth	Flattened, broad	Distant, with stout apical setae
C. sollicitans	Flattened, strongly curved, with stout apical tooth	Subconic, with basal papillate elevation	Strongly curved, setose basally, falcate apically	Irregularly curved, with stout apical tooth	Slender, acute	Distant, with stout apical setae
C. cantator	Rounded, curved, with stout apical tooth	Lobed apically, with stout, curved, tapering basal spine	Curved, setose basally, strongly curved, falcate apically	Strongly curved, with stout apical tooth	Rather stout, acute	Distant, with stout apical spines
C. canadensis	Slender, curved, with long apical spine	Apical lobe and basal papillate, setose elevation	Basal portion stout, rounded; apical slender, bent, acute	Strongly curved, with stout apical spine	Slender, furcate, acute	Approximate, with stout apical spines
C. cinereoborealis	Strongly curved, with stout blunt spine	Large apical lobe, basal enlargement and a peculiar, dark, capitate process	Very long, bent, irregular	Small, with strongly recurved point	Approximate, curved, with stout spine	
C. taeniorhynchus	Basal portion enlarged, apical spine long	Subcylindric, with slight basal enlargement	Basal portion curved, apical curved, falcate, with retrorse spine	Slender, swollen, with stout apical hook	Divergent, slender, acute	Rudimentary, with long, straight spines
C. abserratus	Flattened, strongly curved, with long, stout apical spine	Short, thick	Flattened, strongly curved	...	Curved, slender, acute	Long, with stout apical spines
C. impiger	Flattened, twisted, with stout apical spine	Large apical lobes, a pair of stout internal spines midway and a large basal spine	Rudimentary branch curved, apical portion broadly falcate	With stout apical hook	...	Short, distant, with stout apical spines
C. lazarensis	Flattened, strongly curved, with long, stout apical spine	With apical lobe and basal prominence bearing a stout, tapering, curved spine	Curved basally, apical portion falcate, with recurved tip	Curved, with stout apical spine	...	Distant, with short apical spines
C. absobrinus	Slender, tapering, with short apical spine	Nearly conical, with small basal papillate enlargement	Stout, black, curved, tridentate	Irregular, strongly curved, stout apical spine	...	Approximate, margined with even black chitinous spines
C. magnipennis	Stout, curved, with stout apical spine	Subconical with papillate spined process at basal third	Stout, strongly curved, acute, bidentate	Dorsally curved, with 2 or 3 stout teeth	...	Distant, black, with many irregular, long spines
C. territans	Triangular, curved with short, stout apical spine	Subconical, with 2 stout, recurved processes and several spines in a group at the inner apical third	Short, curved, apex rounded, setose	...	...	Distant, thickly spined apically
C. pipiens	Stout, tapering, with short apical spine	Subconical, with group of 3 stout, several smaller spines and a spatulate organ at inner apical third	Short, strongly bent, acute tip	Curved, with stout apical spur	...	Distant, thickly spined apically
C. restuans	Rather slender, strongly curved, with short apical spur	With 3 large and a smaller, strongly recurved spine and a spatulate organ at inner apical third	Strongly curved with stout, apical hook	...	...	Distant, thickly spined apically
Aedes fuscus	Subapical, strongly curved, with broad base and subapical tooth	Conical, with basal papillate, setose area	Short, furcate, inner branch shorter both obtuse, setose	Widely separated, rounded, papillate and finely setose apically	Confluent, terminating in a slender beak	
Uranotaenia sapphirina	Rather short, excavated, dentate apically, subapical triangular spine	Subconical, rounded	Flattened, with stout apical hook	Short, stout, with stout subapical spine	Short, stout, with lateral apical teeth	Approximate, with short terminal spines
Sayomyia hudsoni	Long, stout, apex rounded	Subcylindric	Short, flattened, spatulate, with short, subterminal spine			
S. rotundifolia	Rather slender, tapering, apex rounded	Subcylindric	Strongly curved, with stout apical and subapical spine			
Eucorethra underwoodi	Stout at base, slightly curved, with short apical spur	Subconical, with conspicuous subapical group of spines internally	...	...	...	Distant, fingerlike

Generic key of culicid larvae

Mosquito larvae are preeminently important in any work designed to reduce the abundance of adults, because most of it must be done before the mosquitos attain maturity, and ordinarily it is impracticable to breed out the insects in order to ascertain whether a pool is liable to produce an annoying or dangerous species or not. This makes identification of larval forms of great importance, and the following generic table modified from that prepared by Mr Johannsen, is given as an aid in identification.

a Air tube on last abdominal segment
- *b* Antennae pendant, with four large, curved, apical spines......Corethra
- *bb* Antennae not pendant
  - *c* Antennae fold back against the head and terminate in two or three claws ....Corethrella
  - *cc* Antennae usually with only a few small erect bristles and one or two pointed processes
    - *d* Brush projecting sidewise from the mouth, mandibles long, sharply toothed. A large species, half an inch or more long...............................Psorophora (ciliata)
    - *dd* Brush of hairs projecting forward from the mouth
      - *e* No ventral brush on last abdominal segment. With two anal blood gills; the pecten of the air tube wanting. Small species occurring in water of pitcher plants.......Aedes (smithii)
      - *ee* Last segment with ventral brush
        - *f* Anal blood gills dilated; lateral comb of eighth segment a single transverse row of spines with elongate bases; anal segment without hair tufts before barred area Stegomyia (fasciata)
        - *ff* Anal blood gills slender
          - *g* Anal blood gills sharply pointed; pecten unidentate, apical 2 or 3 distant, flattened; lateral comb of eighth segment with 12 large spines in a single or partly double row Aedes (fuscus)
          - *gg* Not as above in all respects
            - *h* Pecten teeth with semitransparent serrate margin, stellate hairs on the abdomen, a small species..Uranotaenia
            - *hh* Not as above.......................................Culex

aa No air tube on last abdominal segment
- *b* Last segment usually with hooks; no spiracles apparent; larvae transparent, glasslike...Sayomyia
- *bb* Last segment with a flat dorsal area in which may be seen two spiracles
  - *c* Medium sized species with anal segment cylindric........Anopheles
  - *cc* Large species with the anal segment bladderlike; mandibles strongly developed ....Eucorethra

ANOPHELINAE

ANOPHELES

This genus is of particular interest, because certain species at least, are known to transmit malaria. Members of this group may be recognized by the nearly straight beak or proboscis, and more easily when at rest by the peculiar position, since the body, head and beak are almost in a straight line, whereas there is a marked angle between the body and the head and beak in our common mosquitos. The palpi in both sexes are almost as long as the proboscis, the body colors are brown and yellow, and the wings are usually spotted. Three species occur within the State and may be separated by the characteristics given below.

Anopheles punctipennis Say

Pl. 1, 14, 29, 48, fig. 1, 2, 3; 1, 2; 1; 1 respectively

This is the species we found abundantly about Albany. We have seen it on Long Island, in the Adirondacks and other

Fig. 6 *Anopheles punctipennis*, female, with male antenna at right and wing tip showing venation at left. (After Howard, U. S. Dep't Agric. Div. Ent. Bul. 25, n. s. 1900)

places, indicating a wide range. It may be easily distinguished from the closely allied *A. maculipennis*, by the

yellowish white marginal spot near the apical fourth of the wing. This insect has been characterized by Dr Howard as our handsomest species. This larva with its conspicuously spotted head may be recognized by its nearly horizontal position at the surface of the water, and particularly by the five conspicuous, plumose hairs extending from each side of the thoracic and anterior abdominal segments much like oars. A closer examination will show that the larva normally feeds with its head reversed. It is only about 5 or 6 mm long when full grown. Both sexes and larvae and pupae have been carefully described by Johannsen.

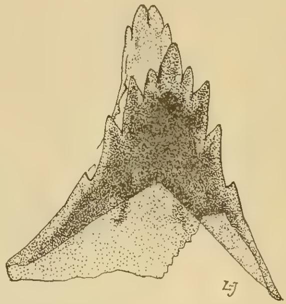


Fig. 7 Labial plate of the larva of A. punctipennis

This species has an extensive range, having been reported from a number of Eastern states, as far south as Texas, west to Oregon, and from Canadian localities. It is probably somewhat generally distributed in this country.

We have taken the larvae from water puddles, pools containing algae, and from other standing waters. This species breeds throughout the summer in favorable localities, and the larvae are occasionally quite abundant.

Anopheles maculipennis Meig.

Pl. 1, 14, 25, 29, 48, fig. 4, 5; 3, 4, 4; 2; 2 respectively

This rather insignificant species may be recognized by its yellow colored wings bearing four somewhat small dark spots. It is also peculiar in possessing black palpi and in having the scales of the last vein of the wing entirely black. The female and larva of this species have been carefully described by Johannsen.

Male. Palpi and proboscis about equal, dark brown, except that the tip of the latter is light brown. Antennae dark brown, shorter than the palpi, segments sparsely clothed with basal whorls of long, black hairs and numerous much shorter, light brown ones. Eyes coarsely granulate, strongly emarginate, with

bright greenish reflections. Occiput rather thickly clothed with black and creamy white scales, the latter forming a pair of submedian patches, dark scales being specially abundant laterally. Thorax brown, sparsely clothed with short, golden yellowish

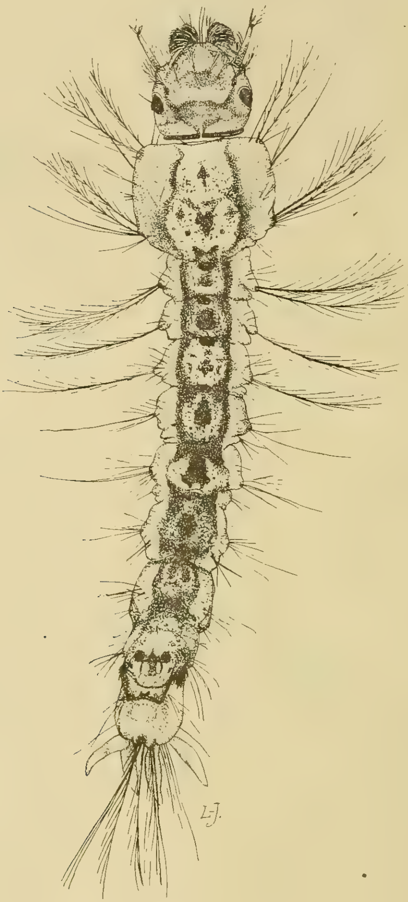


Fig. 8 Dorsal view of the larva of Anopheles

hairs arranged in a rather plain median line with submedian rows, a sublateral and a lateral row posteriorly, the hairs of the two latter being longer, coarser and browner. Scutellum slaty gray. Halteres, basal portion, pale yellowish white; apical portion, capitate, fuscous. Dorsal portion of abdomen plumbeus, with irregular, fuscous markings and rather sparsely clothed with long, golden yellow hairs. Pleura and ventral portion of

abdomen plumbeus. Legs brownish with yellowish apical bands on the femora and tibiae. Wings hyaline, thickly clothed with scales and with darker spots at the base of the second longitudinal vein, the region of the cross veins and the tips of the fork cells. Posterior cross vein almost interstitial with mid cross vein. Petiole of first fork cell about two thirds the length of the cell, that of the second about equal.

This insect occurs on Long Island and about Albany, and it is accorded an extensive range by Theobald, who states that it is widely distributed over Europe. It has been recorded from a number of the Eastern states, and is found from Florida and Texas, north to Canada and Manitoba.

Dr Dyar found the larvae more or less commonly in nearly every pool and pond, and even in rain water barrels at and about Bellport and Amaganset L. I., and Dr Howard states that this species appears to be universally distributed in the suburbs of New York, where it appears to be more numerous than farther north. The larvae occur about Albany only in midsummer and are not abundant then.

The life history of this insect has been worked out by Dr Howard, who states that the eggs are deposited in loose masses on the surface of the water. He adds that they are somewhat oval in outline, float on one side, and that they hatch in three or four days. The larva usually remains near the surface, keeping its body in a nearly horizontal position. The head of the larva revolves easily, and though its normal position is with the back upward, its head is frequently reversed to facilitate feeding on algae, bits of dust and other floating matter. The specific gravity of this larva is slightly less than water; consequently it requires an effort on its part to sink, the reverse of what obtains in Culex. The larva period lasted 16 days in the case observed by Dr Howard, and the pupa from 5 to 10 days, dependent on the weather. The life cycle may be summarized as follows: egg 3 days, larva 16 days, pupa 5 days, making a total of 24 days, a portion of which was passed in somewhat cool weather. The larval comb of this species and that of the preceding are illustrated on plate 48.

Anopheles cruicians Wied.

We have not met with this species. Dr Dyar records it as the commonest Anopheles in houses about Bellport and Amaganset L. I. It may be recognized by the white bases of the last four segments of the palpi, the white scales on the last vein, and the three black spots on the wings.

Adults and larvae of this species were met with by Dr Smith almost daily from Aug. 3 to Sep. 28 in the Cape marsh. He states that the females begin their attack before sundown and are active for a little time after sunrise.

This insect has been recorded from a number of Southern states, where it appears to be somewhat abundant in certain localities, since Weidemann states that it is very common on the Mississippi.

The larva, according to Dr Smith, does not differ in general appearance from those of A. maculipennis and A. punctipennis, and ranges only from 5½ to 6 mm in length. The head is broader just behind the eyes, narrowing to a rounded front and is variably marked, the larger blotches, as a rule, being central. There is a transverse row of six branched hairs before the middle of the head and the antennae, borne on distinct sclerites, are set with little spines and are shorter, stouter and much darker than in allied species. The mandibles differ from those of its allies by having four instead of three curved spines on the dorsal surface. The thorax is subquadrate, angles rounded and with six lateral tufts of branching hairs and similar ones on the dorsum. The comb on the eighth segment consists of from six to eight long teeth separated by from one to four short, compound teeth. The tracheal gills are less than one half as long as those of allied forms.

CULICINAE

This subfamily includes by far the largest number of species, and its representatives are the ones most commonly met with about houses and in woods. The females have short palpi, while they are long in the male. We have in this subfamily several genera, such as Janthinosoma, which latter agrees closely in all structural details with Culex except for the densely scaled legs and is separated from other genera possessing this character by the venation of the wings, which is the same as in Culex, and by the broad, spindle-shaped scales of the head. This subfamily also includes among native forms the giant Psorophora ciliata Abr., a species with densely scaled legs, and Stegomyia, which is of particular interest because certain species are known agents in disseminating yellow fever. A number of other genera have been separated on minor structural differences.

Key to genera[1]

a Legs densely clothed with coarse erect scales..............Psorophora
aa Legs densely clothed with somewhat appressed scales; joints of posterior tarsi usually white..........................Janthinosoma
aaa Legs uniformly clothed with flat scales
  b Head scales all flat and broad...........................Stegomyia
  bb Head scales narrow, curved and with upright forked ones and flat lateral ones
    c Lateral scales of wings linear.............................Culex
    cc Lateral scales of wings elongate, oval or lanceolate.............. Taeniorhynchus

[1]Prepared by D. B. Young.

Psorophora ciliata Abr.

Giant mosquito

Pl. 2, 15, 30, 41, fig. 1, 2; 1; 1; 1 respectively

This species is the giant of its family and may be recognized by its extremely large size and the peculiar legs, which latter

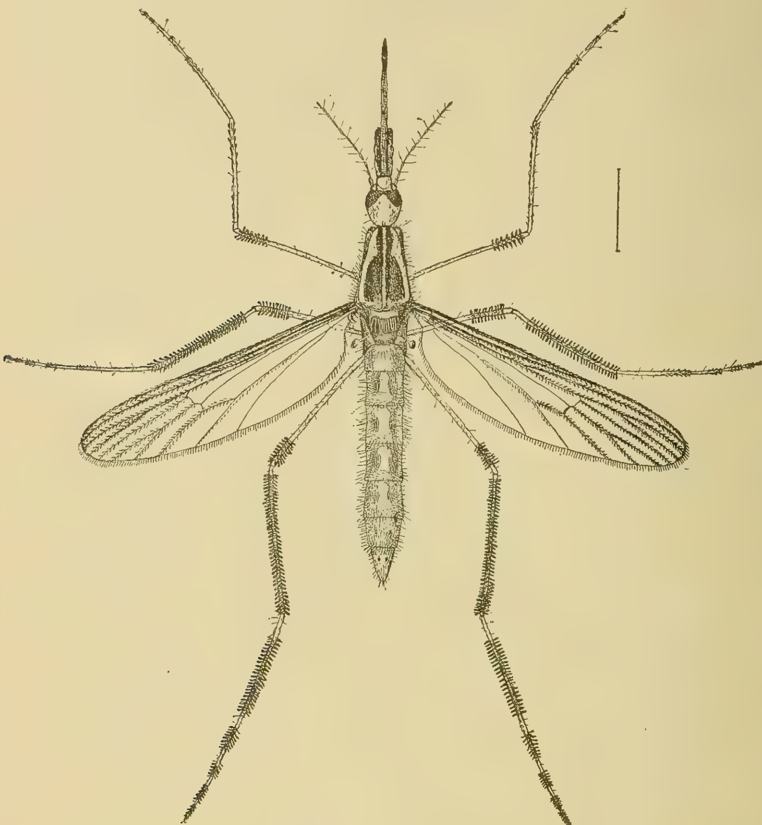


Fig. 9 Female enlarged, Psorophora ciliata. (After Howard. U. S. Dep't Agric. Div. Ent. Bul. 25, n. s. 1900)

are thickly clothed with nearly or quite erect scales [fig. 10]. Under a lens this giant mosquito is a beautiful object with its median band of golden yellow scales on the prothorax, flanked with a smooth, jet black area and more laterally with a somewhat irregular patch of whitish scales. It presents a greater

contrast than any mosquito known to us, which is hightened by the apparently clubbed femora, due to the bands of nearly erect scales at their extremities and the basal yellowish white bands of the tarsi. The wings are clothed with thin, easily abraded

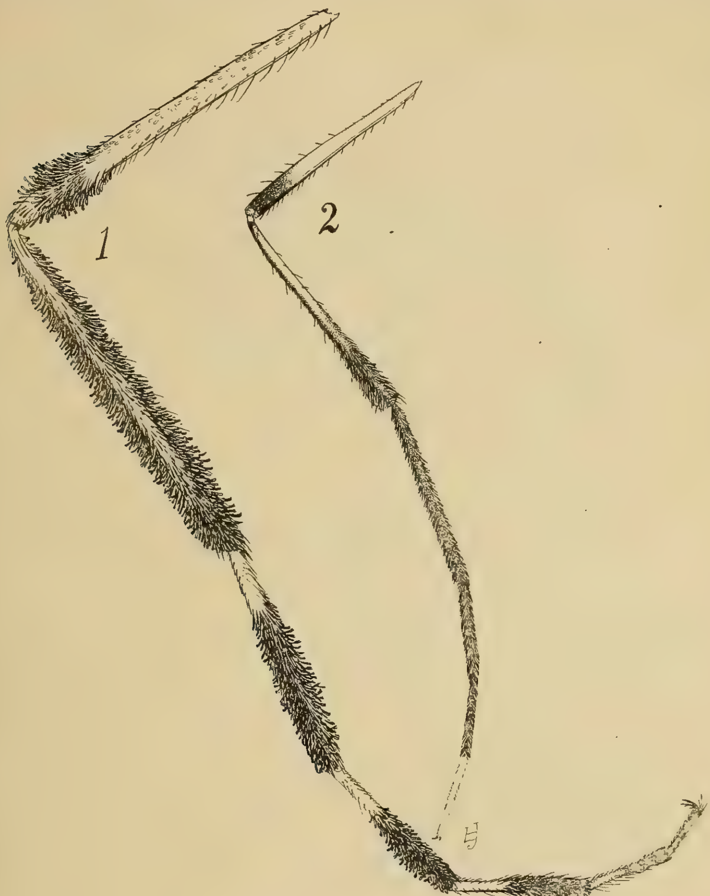


Fig. 10 Legs showing peculiar scaling and marking: 1 Psorophora ciliata, 2 Janthinosoma musica, both equally enlarged

scales. This insect is really yellowish, though somewhat dark in general appearance.

The larva is equally remarkable in appearance and when full grown is stout and half an inch or more in length. It is culicid in type and presents some very interesting structural modifica

tions. The head is nearly square viewed from above. The antennae are rather stout, tapering uniformly and tipped with two rather large tapering spines and a very short, stout remnant of a segment. There are also several minor conical processes. The man-

Fig. 11 Larval mandible of Psorophora ciliatá

dibles are extremely well developed, being provided with three major processes. The two ventral ones are coarsely dentate. The triangular labial plate is remarkable because its 17 teeth are at nearly right angles to the plate, the two lateral ones on each side being very large. The comb is present on the eighth segment and is remarkable on account of its interesting modification. Its posterior border is marked by a semicircle of about 15 stout scales with large, spatulate bases, each bearing a large, apical spine and one or two smaller ones on each side. In addition, there are anterior to these larger scales many smaller, beautiful, platelike organs, each margined posteriorly with from about 8 to over 20 fine, rather evenly set spines. The chitinous portion of

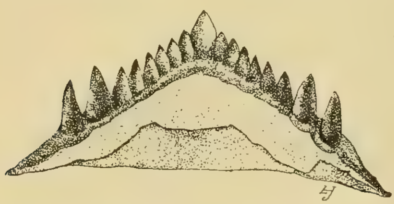


Fig. 12 Labial plate of the larva of Psorophora ciliata

the air tube is set on a fleshy elevation, which is probably extensile. The chitinous portion of the tube proper is about four times as long as its greatest diameter. The double row of posterior pecten is present but remarkably modified, consisting of small

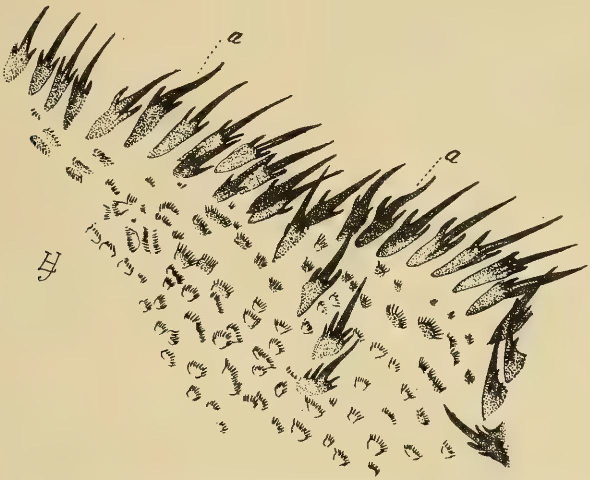


Fig. 13 Superimposed combs of Psorophora ciliata, showing the peculiar, small scales in front of the larger ones

tubercles bearing one very long, slender seta and a very short, conical process of about equal size.

Habits and life history. This species appears to be widely distributed in New York State, having been taken in several localities. The mosquito is vicious and bites readily in the daytime. It has been reported by various authors from a number of the Eastern states, ranging as far south as Texas and west to California. It has also been reported from several South American countries, but so far as known to us it has not been taken in the eastern hemisphere.

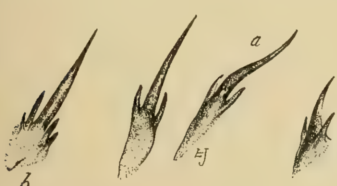


Fig. 14 Several larval comb scales of Psorophora ciliata very much enlarged

The life history of this insect was unknown till August 1900, when some of its giant larvae were obtained by Dr Howard from

depressions in the bed of a small stream and in similar hollows in small ponds, all of which were dry the greater part of the summer. We have also met with the larvae in some numbers in temporary pools at Karner, they being found only in the early part

Fig. 15 Several small comb scales of Psorophora ciliata very much enlarged

Fig. 16 Middle tarsal claw of Janthinosoma musica

of June. The larvae are predaceous and devour large numbers of Culex, with which they are associated, and are consequently beneficial. The duration of the pupa state has been reported as from four to five days. The eggs of this species were obtained by Dr H. F. Harris of Atlanta Ga., who states that they are black and measure about .7 mm in length, and that when viewed with a high power lens they are found to be distinctly convex on one side and slightly concave on the other, having an oval form when seen from either of the surfaces.

Janthinosoma musica Say

Big wood mosquito

Pl. 2, 15, fig. 3, 2 respectively

This species may be recognized by the densely scaled legs, and by having the last two joints of the posterior tarsi white [fig. 10]. The peculiar character of the claws is shown at figure 16. These differ considerably from Theobald's drawings made from South

American specimens, but examination of specimens from that country reveals very little if any difference.

This mosquito is said by Howard to be rather rare. It has been taken, though not bred, in New Jersey by Dr Smith and was described by Say from Indiana. Theobald records it in addition from Rio Janeiro, British Guiana and South Amazon. He states that it seems to be an abundant South American form, and our observations show that it was present in considerable numbers in woods near Poughkeepsie in July. It is a large, handsome mosquito with bluish reflections in the sunlight. It is one of the most vicious biters we have seen and at the same time one of the most wary, since it takes to wing much quicker than other species on the approach of a net or cyanid bottle. It was found indifferently in both sunlight and shade.

CULEX

Members of this genus may be recognized by the more or less erect forked scales on the head, and the linear, lateral scales of the wing veins. Most of the characters used in the separation of the species are well illustrated in figure 5 reproduced by permission of Dr J. B. Smith, state entomologist of New Jersey.

Key for determining females of the genus Culex[1]

a Tarsal joints banded at the base
- *b* Proboscis without a white band
  - *c* Claws all toothed
    - *d* Bases of anterior abdominal segments with patches of yellowish white scales
      - *e* Scales of sides and pleura pale yellow; posterior cross vein less than its own length from one above.....s q u a m i g e r, p.281
      - *ee* Scales of sides and pleura white; posterior cross vein its own length at least from one above..............f i t c h i i, p.281
    - *dd* Bases of abdominal segments distinctly banded with whitish scales
      - *e* Tarsal bands broad..........................c a n t a n s, p.284
      - *ee* Tarsal bands narrow....................s y l v e s t r i s, p.289
  - *cc* Posterior claws simple; tarsal bands narrow....c a n t a t o r, p.293
- *bb* Proboscis with a more or less distinct white band
  - *c* Abdomen with a central stripe of yellowish scales on dorsum ....s o l l i c i t a n s, p.294
  - *cc* Abdomen without such stripe

[1]Prepared by D. B. Young.

d Wings spotted..............................d i s c o l o r, p.297
dd Wings with 1 black spot where the 3d longitudinal vein meets the cross veins, tibia spotted..........j a m a i c e n s i s, p.298
ddd Wings not spotted
e Femora without white band.......t a e n i o r h y n c h u s, p.301
ee Femora with white band...................c o n f i n i s, p.302
aa Tarsal joints banded at middle
b Metatarsi with a broad median band; femora also with a broad yellowish ring near the black apex...............a n n u l a t u s, p.303
aaa Tarsal joints banded at both ends
b Petiole of 1st submarginal cell more than ½ as long as cell
c No median white stripe on dorsum of abdomen
c a n a d e n s i s, p.303
cc Median white stripe on dorsum of abdomen
o n o n d a g e n s i s, p.304
bb Petiole of 1st submarginal cell less than ½ as long as cell
c Last joint of hind tarsi white.................a t r o p a l p u s, p.305
cc Last joint of hind tarsi not white...................d y a r i, p.306
aaaa Tarsal joints not banded
b Abdomen with cross bands of whitish scales at apex of the segment ....t e r r i t a n s, p.307
bb Abdomen with cross bands of whitish scales at base of segment
c Posterior cross vein of wing its own length or less from mid cross vein
d Claws toothed
e Species large, 6-7 mm long
f Thorax vittate with 2 dark brown lines..l a z a r e n s i s, p.309
ff Thorax not vittate; curved scales of head white
c i n e r e o b o r e a l i s, p.312
ee Species small, 4½–6 mm long; curved scales of head golden brown ....i m p i g e r, p.316
dd Claws simple
e Basal bands white......................a b s o b r i n u s, p.318
ee Basal bands orange mesally, yellowish white laterally; legs flecked with white scales............m a g n i p e n n i s, p.322
cc Posterior cross vein of wing its own length or more from mid cross vein
d Thorax with spots; apex of tarsal joints slightly whitish
r e s t u a n s, p.325
dd Thorax spotless
e Cross bands of abdomen distinct
Relative length of petiole of first submarginal cell
f ⅐ length of cell, claws simple.............p i p i e n s p.328
ff ½ length of cell, claws toothed.......a b s e r r a t u s p.329
fff ⅔ length of cell, claws simple................d y a r i p.306
ffff Longer than cell, claws toothed.....n e m o r o s u s p.332
ee Cross bands of abdomen indistinct, widest in middle, a smaller species ....s a l i n a r i u s, p.332

bbb Abdomen without cross band of whitish scales
c Thorax vittate or distinctly striped with white or yellow
d Thorax with 2 broad yellowish stripes, 1 each side of a central dark brown one........................t r i v i t t a t u s, p.333
dd Thorax with 1 median creamy gray stripe....s e r r a t u s, p.334
ddd Thorax with broader median, creamy gray stripe, species smaller ....d u p r e e i, p.334
cc Thorax not vittate with white or yellow
d Some of the claws toothed
e Scales on side of mesonotum white......t r i s e r i a t u s, p.335
ee Scales on side of mesonotum golden yellow...a u r i f e r, p.336
dd Claws simple..........................m e l a n u r u s, p.337

Key for determining Culex larvae

Characters employed in earlier published keys have been used wherever they could be employed to advantage.

a Air tube long, at least 4 times as long as the diameter of its base
b Air tube very long, slender, slightly constricted in the middle; antennae white banded..........................t e r r i t a n s, p.307
bb Air tube very long, stout, tapering uniformly
c Comb scales 60, pecten teeth 3–4 branched...s a l i n a r i u s, p.332
cc Comb scales about 80, pecten apparently simple......d y a r i, p.306
bbb Air tube about 5 times the width of its base, tapering
c Pecten teeth pale, divided into 3–5 long, slender processes
d Antennal tuft before the middle..............r e s t u a n s, p.325
dd Antennal tuft at outer third.................p i p i e n s, p.328
cc Pecten teeth almost black, 20, with small basal dentitions; comb scales about 25 (*See also* p.381)................f i t c h i i, p.281
aa Air tube very short, not more than 1½ to 2 times as long as broad
b Pecten teeth dentate on both sides; comb with 16–24 scales; head maculate ....t a e n i o r h y n c h u s, p.301
bb Pecten teeth dentate on one side only
c Antennal tuft normal
d Comb scales 28–40, pecten teeth about 14, head generally immaculate....................................s o l l i c i t a n s, p.294
dd Comb scales 5, pecten teeth 7–9..............s e r r a t u s, p.334
cc Antennal tuft reduced to a single hair; pecten extending nearly to apex of air tube; comb scales about 46.....a t r o p a l p u s, p.305
aaa Air tube moderate in length, from about 2 to over 4 times longer than its greatest diameter
b Comb scales not more than 10
c Comb scales quadrate, with a very long median spine and shorter lateral ones
d Comb scales 5–8, attached to a slight band; pecten teeth 5–8, dividing into 2–4 very long, slender spines.........d i s c o l o r, p.297
dd Comb scales 7, in a curved row, with 3–4 pecten teeth, each with a long median tooth and several small serrations at its base
j a m a i c e n s i s, p.298

cc Comb scales rather broadly spatulate at the base, few, arranged in a curved line

d Comb scales 5, pecten teeth 7–9, minutely serrate near middle
serratus, p.334

dd Comb scales 6, pecten teeth 12–16, stoutly toothed near middle
abserratus, p.329

ddd Comb scales 8–10 in a curved line; 12 pecten teeth with short basal spines..............................dupreei, p.334

bb Comb scales ranging from 10 to about 24

c One or more pecten teeth widely separated from a continuous row

d 2 rows of slight tufts of hairs on the dorsum of the air tube; comb scales 14–16, usually four pecten teeth widely separated from the remainder of the row....cinereoborealis, p.312

dd No such dorsal tufts on the air tube

e Air tube slender, tapering equally, the continuous pecten extending only to the basal 5th of the air tube; pecten teeth 2–3 toothed; comb scales 10–14 (Smith 18–20)
sylvestris, p.289

ee Air tube stouter, slightly swollen, continuous pecten extending to the basal 3d of the air tube; pecten teeth 1–2 toothed; comb scales 14, in a somewhat triangular patch, spatulate, each with a stout, rather short, terminal spine; pecten teeth 15–18, each with 2 or more basal teeth............impiger[1], p.316

cc Pecten in a continuous row, distal teeth not widely separated

d Comb scales digitately divided, 12, in an irregular double row..................................triseriatus, p.335

dd Comb scales elliptic, with a terminal spine, 14–22
trivittatus, p.333

bbb Comb scales over 25

c Antennal tuft before or at the middle

d Pecten pale, prolonged into setae; comb scales digitately divided

e Comb scales 50, pecten teeth with 1 or 2 basal processes
absobrinus, p.318

ee Comb scales 40, pecten teeth with 2 or 3 basal processes
magnipennis, p.322

dd Pecten not as above

e Tuft of antenna reduced to a single hair; comb scales about 46 in 5 rows; several pecten teeth widely separated from the remainder...............................atropalpus, p.305

ee Tuft of antennae normal

f Comb scales with stout apical spine, 28–64, narrowly spatulate at base; tip of antennae dark....canadensis, p.303

ff Comb scales each with a stout apical spine, broadly spatulate at base

g Antennae moderately long with a slight swelling near the base; 26–50 scales in the comb and 16–24 pecten teeth; head immaculate...............................cantans, p.284

[1]Aedes fuscus larvae also come out here and may be distinguished from this Culex by the comb scales being in a somewhat irregular line, the pecten teeth usually with a single tooth, the apical 2 or 3 pecten teeth distant and somewhat flattened.

gg Antennae shorter, without a swelling near the base, spines and scales as above; head maculate.....c a n t a t o r, p.293

fff Comb scales with 4–6 stout apical spines, somewhat spatulate at base, about 60 in number........l a z a r e n s i s, p.309

c Antennal tuft beyond the middle

d Comb scales about 80 in a triangular patch of 10 rows d y a r i, p.306

dd Comb scales fewer in number

e Pectan pale, 10–15, each tooth with 3 or 4 long basal teeth; comb scales about 50, in a triangular patch.........p i p i e n s, p.328

ee Pecten small, 14–20, minutely toothed; comb scales 25–30 a u r i f e r, p.336

Culex squamiger Coq.

This species was described from California, and as Dr Smith has found it in New Jersey, there is a strong possibility of its occurring in this State.

Description. The original description follows:

Head and its members black, middle of proboscis brownish, scales of occiput mixed golden and pale yellow, many black ones along the eyes, palpi black scaled, those at base, before the middle and at apex white; body black, scales of middle of mesonotum golden brown, those along the sides and on the pleura pale yellow, bristly hairs of thorax mostly black, those of scutellum chiefly yellow; scales of abdomen black, a large patch at base of each segment and several scales scattered over the remainder pale yellow, scales of venter pale yellow; femora and tibiae brown, the scales mixed black and yellow, not forming distinct bands, posterior side of the femora yellow and yellow scaled; tarsi black, the scales mixed black and yellow, a band of whitish scales at bases of the last four joints, claws toothed; wings hyaline, veins yellow, densely covered with rather broad mixed brown and whitish scales and with many very narrow ones in the apical third of the wing, petiole of first submarginal cell about two thirds as long as that cell, cross vein at apex of second basal cell less than its length from the one above it; halteres yellow, the knobs marked with brown; length, 5 mm.

Culex fitchii Felt & Young

Pl. 2, 3, 15, 41, 48, fig. 4; 1; 3, 4; 2; 3 respectively

This species was bred from a woodland pool at Karner N. Y., larvae being obtained May 10 and adults emerging May 16.

Description. *Female.* Basal segment of antennae clothed interiorly with broad white scales. Proboscis dark brown, long; palpi

dark brown, segments narrowly ringed at the base with white; occiput clothed with brown scales, with a row of silvery ones just above the eyes and along the median line. Thorax with a broad,

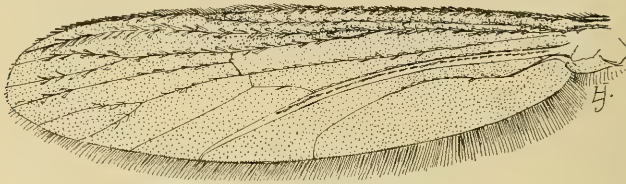


Fig. 17 Wing of Culex fitchii

brown, central stripe bordered with a rather well defined, silvery, slightly broader, lateral stripe containing a few brown blotches. Pleura rather thickly clothed with patches of silvery white scales.

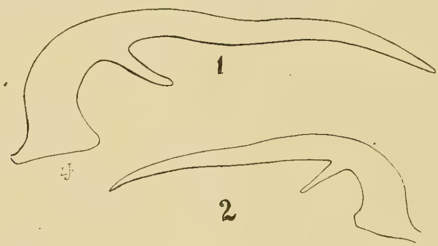


Fig. 18 Tarsal claws: 1 C. cantans, 2 C. fitchii

Abdomen brown, with broad, basal, yellowish white patches, those of the anterior three segments being distinctly prolonged on the median line and with a slight indication of the same laterally, giving a somewhat lobular appearance; the other segments with

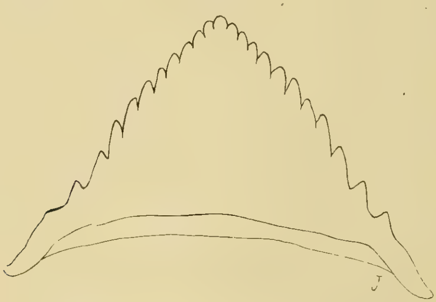


Fig. 19 Labial plate of C. fitchii

a rather broad basal band, slightly wider in the middle. Ventral surface thickly covered with silvery white scales. Coxae clothed with white scales; inside of femora and tibiae thickly mottled with the same; dorsal surface brown. Tarsi dark brown, almost black; basal portions of segments ringed with yellowish white,

except the first segment of the anterior legs. Claws unidentate, concave surface of teeth finely serrate. Wing veins dark, thickly clothed with mixed yellow and brown scales. Petiole of first submarginal cell shorter than the cell, that of the second, longer; posterior cross vein about its own length from the mid cross vein. Length $\frac{3}{16}$ inch.

Bred from an isolated larva and described while fresh.

Male. Palpi brown, tipped with grayish yellow hairs, and with a broad, yellowish white band near the base of the third seg-

Fig. 20 Comb scale much enlarged of C. fitchii

Fig. 21 Air tube of C. fitchii

Fig. 22 Pecten tooth of C. fitchii much enlarged

ment; underside of second, whitish. Thorax with a broad stripe of golden brown scales separated by a narrow, median, brown line and bordered laterally by a broad area of silvery gray scales with a few brown patches interspersed. Abdomen brown, with broad, basal bands on first and second segments, narrow on the following ones. Legs marked as in the female, except that the tarsal bands are broader; ungues unidentate; claws of anterior and middle legs unequal, the longer claw of the middle leg being nearly straight and quite different from the sinuous one of C. cantans. Petiole of first submarginal cell distinctly longer than the cell, and posterior cross vein less than its own length from the middle cross vein. Length ¼ inch.

Bred from isolated larva taken from permanent pool at Karner May 12, adult appearing May 16.

Larva. About ¼ of an inch long. Head probably pale brown; antennae slender, slightly curved, dark at tips; tuft just before the middle, and the curved surface thickly clothed with fine scales, giving the edge a peculiar serrate appearance. Labial plate broadly rounded, with 23 teeth. Comb is composed of about 25 triangular, stoutly spined scales arranged in two or more rows; some of the scales have a very stout, terminal spine with smaller ones along each side, while others have the tips somewhat rounded and the spines more nearly of a size. Air tube fully five times as long as its greatest diameter, tapering somewhat regularly and with a slight bend and contraction near the middle. Basal rows of pecten, each consisting of about 22 closely set teeth bearing at their bases usually two larger and three or four finer serrations. There is a compound bunch of hairs slightly beyond the row of pecten, all on the basal half of the tube. Ventral tuft rather thick, confined to the barred area; dorsal tuft composed of one rather large, compound hair and two very long, slender hairs, the latter being about half the length of the body.

Described from cast skins of isolated larvae from which adults were bred.

This larva was associated with C. canadensis, C. cantans, C. cinereoborealis, C. impiger and Aedes fuscus in a rather permanent woodland pool. It proved quite difficult to rear.

Culex cantans Meig.

Brown wood mosquito

Pl. 3, 16, 30, 41, 49, 50, fig. 2, 3; 1, 2; 2; 4; 3; 1 respectively

This common mosquito (C. stimulans of Coquillett's table) may be distinguished from others having basal bands on the tarsi, by their being wider as compared with those of C. sylvestris [fig. 24], and from the other three native species because all the claws bear a tooth. Theobald and Johannsen were both mistaken in supposing that the posterior claws were simple [fig. 23], and the former has corrected the error in his third volume on the *Culicidae of the World.*

Fig. 23 Posterior claw of Culex cantans

This species was taken at Delmar in a woodland pool, Ap. 25, 1903, and a number of adults bred therefrom up to June 19, and at

Karner, May 1904. It was associated with C. canadensis, C. impiger, C. cinereoborealis and Aedes fuscus.

Larva. Head, dark brown; the antennae pale brown, darker at tip and with scanty tuft arising before the middle of the joint. Labial plate triangular and toothed as illustrated in the figure.

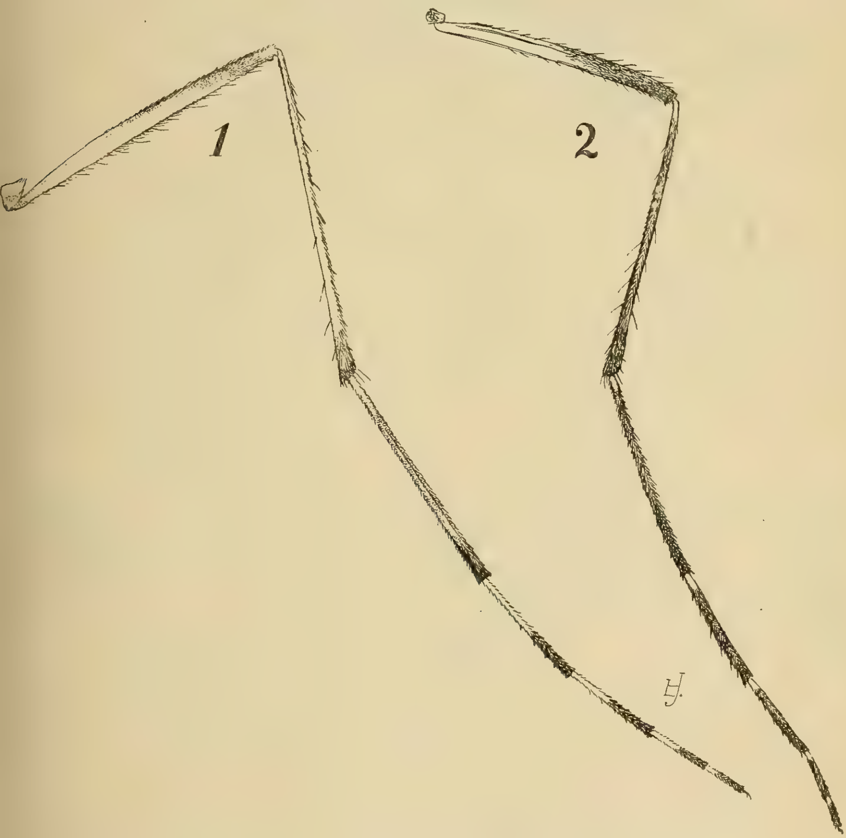


Fig. 24 Legs illustrating banding; 1 C. cantans, 2 C. sylvestris

Thoracic hairs fine, weakly barbuled, arising from large dark tubercles; abdominal hairs much finer, simple. Anal segment with a broad dorsal plate extending nearly to the ventral line but not inclosing the segment. Dorsal and ventral tufts as represented in figure 26. Air tube nearly cylindric, tapering slightly, and with double row of pecten, each terminated by a branched

hair, pecten with three prominent and several smaller serrations [fig. 30]. The comb consists of a somewhat irregular patch of scales arranged in about three rows, each scale being somewhat spatulate and tipped with numerous fine hairs and a terminal coarser spine [fig. 28].

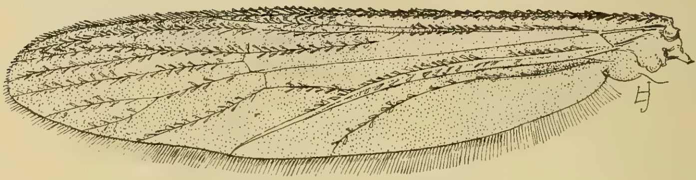


Fig. 25 Wing of C. cantans

This larva according to Dr Smith is somewhat larger and more robust than C. canadensis, which latter is frequently found in woodland pools and springs associated with

Fig. 26 Larva of C. cantans

this species. The two larvae are not easily separated, though this form has shorter, stouter antennae. Both have short breathing tubes, but that of C. cantans is shorter and approaches the form of C. sollicitans, with which it is also associated in brackish pools on salt meadows. The latter has still shorter, more slender antennae and has the labrum oblong, truncate, while in C. cantans it is rounded, and as a whole, somewhat heart-shaped.

Dr Dyar states that the labial plate of the full grown larva is broadly triangular with coarse teeth at the sides and fine ones near the apex. He states that the regularly tapering, long air tube

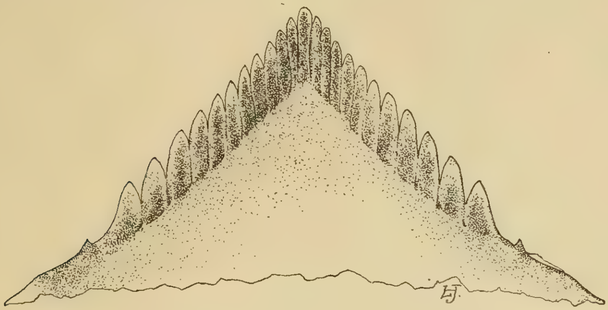


Fig. 27 Labial plate of C. cantans

is fully four times as long as wide, and that the basal pecten on the air tube are distant, the last two spines being large and detached, followed by a single hair tuft at about the middle of the

Fig. 28 Comb of C. cantans

tube. The comb consists of a patch of about 28 single, thorn-shaped scales which are minutely divided nearly to the base. This description agrees closely with illustrations published by Dr Smith, who represents the comb as containing about 29 scales and

states that the number ranges from 26 to 50, each scale bearing a central spine, with others more slender and nearly as long on each side and extending down the base. Mr Johannsen states that the comb of this species consists of from 35 to 40 scales. There is also a difference in the pecten on the air tube, as illustrated by

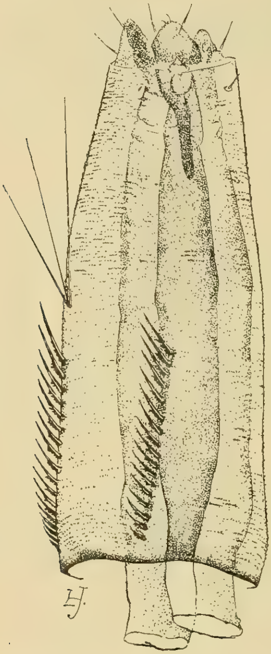


Fig. 29 Air tube of C. cantans

Fig. 30 Pecten tooth much enlarged

Drs Smith and Dyar. Dr Dyar states that the eggs are elliptic, the thickest part one third from the micropyle, one side flattened; finely marked with elongate reticulations.

The larvae from which we have reared this species do not present any such marked variation as a rule. The number of scales on the comb ranges from about 28 to 32, the air tube is only about three times as long as broad, and the pecten is continuous, with no isolated spines near the tip, and slightly beyond there is a compound hair, as represented in the figure.

Both sexes, larva and pupa, have been carefully described by Johannsen.

Distribution. This species is widely distributed in America, having been recorded by Howard from a number of New England and New York localities, from Ottawa, Canada, and in the Saskatchewan river, British America, Colorado, Arizona, New Mexico and Mexico, while Theobald lists it on the authority of various writers, from England, Germany, Scandinavia, Russia, Italy, India and Australia.

Life history and habits. This mosquito is very common at Poughkeepsie, and according to Dr Dyar flies most of the summer, though there is but one generation. The larvae appear to survive the winter in this latitude, though Dr Dyar states that they hatch from overwintering eggs very early in the spring, and that the growth is not rapid, a month probably being required for the production of adults. Our belief is based on the fact that full grown larvae are first observed in the spring and as their appearance is nearly coincident with that of other aquatic forms, we doubt the possibility of their developing from eggs in this latitude. Dr Dyar states that this species flies some weeks before depositing eggs and becomes common in the woods of British Columbia in July, disappearing soon after. A female taken by him, in New Hampshire, was kept alive from July 20 to Aug. 12, and another captured Aug. 8 laid eggs the 16th. A female taken June 15 in British Columbia oviposited the 30th, the eggs remaining unhatched till the following year, the wrigglers appearing as soon as the ice had melted from the jar the next spring. The eggs are laid singly and readily sink in the water. Dr Smith states that the larvae of this mosquito occur in woodland pools and springs in early spring with those of C. canadensis.

Culex sylvestris Theo.

Swamp mosquito

Pl. 3, 16, 31, 42, 49, fig. 4, 5; 3, 4; 1; 5; 1 respectively

This exceedingly common species about Albany has been taken in widely separated New York localities. It greatly resembles C. cantans according to Johannsen, and also agrees fairly

well with the description of C. vexans Meig. and with Walker's description of C. stimulans. It differs from the first in having an unmarked thorax, and only the immediate base of the tarsal joints white [fig. 24]. The male also has the long claw of the middle tarsus slightly curved, though not sinuous. It may be separated from C. stimulans by the posterior forked cell being wider and shorter than the anterior, while in C. stimulans according to Giles they are of about equal length and breadth. The male differs from the above, in having a white band on the middle of the second joint of the palpus. This is probably Culex sylvestris Theo. though a specimen received from him has the hind claws simple and a lateral white stripe on the side of the head, whereas our form has toothed hind

Fig. 31 Claw of Culex sylvestris

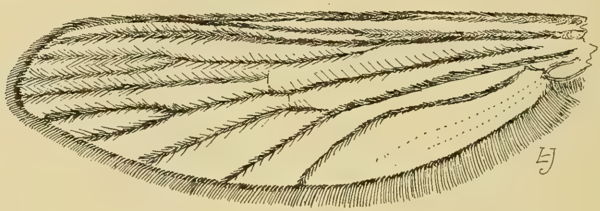


Fig. 32 Wing of C. sylvestris

claws and the lower, lateral portion of the head entirely white, as a rule. A very few specimens agree with the one received from Theobald. It is possible that we have two species. This can be determined only by rearing extensive series. The tarsal bands are much narrower than in C. cantans, and the species is readily separated from C. jamaicensis by the petiole (in the female) of the first submarignal cell being considerably more than one third the length of the cell.

Description. The eggs according to Dr Dyar are laid singly or in groups, adhering by capillary action only, floating for a time and ultimately sinking. They are elliptic and fusiform with ends rounded, pointed and about alike, one side more flattened than the

other. They are smooth, shining black, free of mucilage, without granulations, coarsely reticulate, and the reticulations much elongated lengthwise of the egg, forming long lines of chains. Length, .6 mm.

The larva is rather stout, medium size, and has a rounded, light brown head, slender, moderate antennae, slightly tapering, a small tuft before the middle. The labial plate is shown at figure 33. The tube is moderate, about two and one half times as long

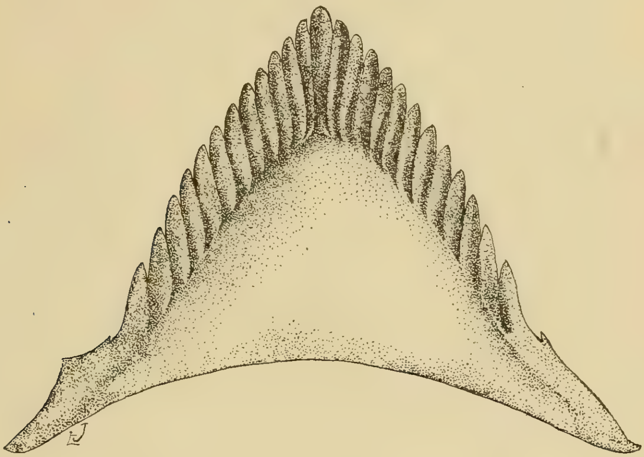


Fig. 33 Labial plate of C. sylvestris

as wide, slightly tapered, with double posterior pecten on the basal half, each row consisting of about 20 dark spines, three toothed, the terminal two or three usually detached and larger. The lateral comb consists of about 12 large thorn-shaped scales in an irregular partly double row. Dr Smith gives the number at 18 to 20 while our specimens have but 10 to 14. The pupa is normal, rather large, with slender funnel-shaped moderate air tubes.

Life history and habits. This species appears to be common in New York State, since we have taken the larvae in numbers from June till late fall, they occurring even after ice had formed on the pools. The winter is possibly passed in this stage in New York, though larvae brought in continued

to mature till the first of December. This species has also been taken at Ithaca.

Dr Dyar has met with this species in New Hampshire, where the larvae occurred in all sorts of temporary pools, swamps, meadows, roadside puddles and the like. They were associated with C. canadensis and Aedes fuscus, and he states that the three species have essentially similar habits. He records collecting all the larvae from a roadside puddle, and on visiting it after the next rain found it filled with the same three species, and he therefore inclines to the belief that the eggs were lying in that place and that some hatched after each rain. Dr Smith states that this species occurs throughout New Jersey, and that it is the most common of the fresh-water swamp mosquitos after midsummer and till well along into fall. It bites readily, often occurs in considerable swarms, flies quite a distance and frequently enters houses. He adds that this species prefers rather open swamps and is as common in New Jersey in the marshy stretches near the Delaware, as in the low areas of the Great Piece meadow region. He states that it is rarely found in dark woodland swamps or in cat-tail areas, but that it occurs in more open water. It breeds in larger, more permanent meadow or lot pools and rarely in clean gutters. It is not a foul water mosquito and does not ordinarily occur in tubs, pails or rain barrels, nor has he ever found it in rain water or in open ponds.

Dr Smith states that the winter is passed in the egg stage and usually at the bottom of a pool, though the eggs may be laid at the edge of a puddle or in a damp depression likely to become filled with water. Dr Dyar states that eggs obtained by him from captive females were essentially like those of C. canadensis and C. cantans, laid singly, sinking in the water. They were obtained by him late in the season and did not hatch. Dr Smith records several broods during the season and states that the number depends on the amount of rain that falls and forms or maintains the normal breeding areas. The species breeds in both permanent bodies of water and temporary pools, provided the latter are suitable. The time of development is about 10 days.

He states that this mosquito is to open fresh-water marshes what C. sollicitans and C. cantator are to salt marshes and adds that he has evidence that it flies some distance, say half a mile, though there appear to be no real migrations.

Dr Dyar met with this species in British Columbia, where he states adults occurred in small numbers during July, associated with C. cantans.

Culex cantator Coq.

Brown salt marsh mosquito

Pl. 4, 17, 31, 42, 49, fig. 1, 2; 1, 2; 2; 3; 2 respectively

This is another form which appears to be largely confined to the coast region and to prefer brackish water for breeding purposes. We have taken larvae at Sheepshead bay in a ditch where the salt water entered only at high tide. This form may be separated from C. sylvestris, which it resembles, by its simple posterior claws and by the cross bands on the abdomen being yellowish instead of white.

Description. Dr Smith finds this species associated with C. sollicitans and C. taeniorhynchus, and states that it is a stout, hairy, yellowish brown mosquito with obscurely banded legs, very different from the bright contrasts found in C. sollicitans.

Larvae. Dr Smith states that the larvae of this species often occur in the same pools with those of C. sollicitans and look so much like them that they can not be readily distinguished, except that the anal siphon is obviously longer and the head bears a median, lunate mark with two lateral, slightly smaller posteriolateral ones. He adds that the antennae are shorter, without a basal swelling, and that there are 16 to 24 pecten teeth in each row and that the comb consists of from 26 to 50 spatulate, thorn-tipped scales arranged in about three rows. The labial plate is somewhat rounded and has 21 fine teeth.

Dr Smith states that as a rule this species breeds on salt marshes only. He adds that its power of flight is equal to that of C. sollicitans, and his observations in 1903 indicate that

C. cantator appears earlier and may fly long before the salt marsh mosquito appears in large numbers. He also considers C. cantator more northern in range, since it equals or exceeds the salt marsh mosquito on the Raritan and Newark marshes; it is hardly noticeable from Barnegat bay southward.

Culex sollicitans Walk.

White banded salt marsh mosquito

Pl. 4, 17, 18, 32, 42, 50, fig. 3, 4; 4; 1; 1; 2; 3 respectively

This mosquito is by far the most abundant of our coast species, and the one of greatest economic importance along our seashores.

Fig. 34 Female and toothed front tarsal claw, Culex sollicitans. (After Howard. U. S. Dep't Agric. Div. Ent. Bul. 25. 1900)

It is the species, more than any other, against which extensive efforts have been directed in attempts to reduce its annoying, pestiferous hordes.

Description. This is one of the few species in which the proboscis is marked near the middle with a light colored band. It is readily separated from C. taeniorhynchus Wied. by the yellow median stripe along the dorsum of the abdomen. Abraded

specimens may often be distinguished from closely allied forms by the much darker sides of the thorax compared with the dorsum.

The egg has been described by Dr Smith, as spindle-shaped, just a little curved, shiny and usually black when deposited.

The larva according to Dr Smith is light slate gray in color, head yellow, and without markings of any kind. The anal siphon is short, stout; the antennae short, slender, black at the tip and without obvious set-off or prominent tufting. The shape of the head, and specially of the vertex, is quite characteristic. The labial plate is represented at figure 35. The comb consists of 28 to 40 spatulate, thorn-tipped scales. Larvae of C. cantans and

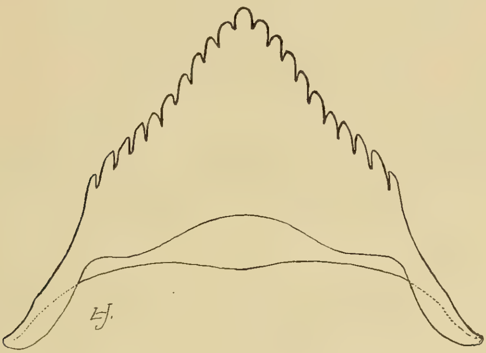


Fig. 35 Labial plate of C. sollicitans

C. taeniorhynchus resemble this species closely and are not easily separated.

The pupa presents no characteristic features.

Distribution. This mosquito has been recorded from various localities along the coast from Maine south to Florida; and from Jamaica. We have taken it about Lake Onondaga, N. Y. Theobald lists it doubtfully from the Galapagos islands and from Tamsui, Formosa.

Life history and habits. This species is such an abundant and annoying form, that considerable space may well be given to a discussion of its habits. The investigations of Dr J. B. Smith, state entomologist of New Jersey, who is doubtless the best posted regarding this mosquito, show that the winter is passed by this species in the egg stage. The eggs remain on or in the black mud,

or at the base of grass stems, till hatched by floods of water at the proper temperature. The first generation is usually small and does not get far from the marshes. These females oviposit in the mud, where the eggs *must* lie dry or nearly so for three or four days before they can hatch, after which the larvae may appear in immense numbers after a high tide or heavy rain. Most of the eggs are high enough, so that they are reached only by exceptional tides or storm-driven water, and as a consequence swarm after swarm of mosquitos may hatch from the same ground at irregular intervals, depending on high tides, unusual rain or storms. This may continue even till early September. Dr Smith's observations show that no gravid females occurred on the Newark meadows between early September and the middle of October, and that consequently most of the eggs must have been deposited prior to that time.

The salt marsh mosquito is somewhat unique on account of its traveling long distances either by flight or by allowing itself to be conveyed by prevailing winds. Dr Smith states that the migration begins soon after the adults emerge and that after the middle of July the entire pine region of South Jersey gradually becomes filled with these insects, where they swarm miles from any water, and at least 40 miles from any point where larvae of this species have ever been found. This migratory habit is remarkable compared with what is known of other species, yet Dr Smith has obtained incontrovertible evidence. It is, however, only fair to state that we have failed to note such extended migrations on Long Island, and we are inclined to the opinion that, as a rule, local control by township or village affords excellent protection from this mosquito. Dr Smith has also given some interesting observations relative to the possibility of this species being conveyed by trains. He has repeatedly noticed the influx of mosquitos when trains entered a region infested by this species, and likewise observed their departure as the infested area was passed, showing that relatively few were conveyed in this manner.

The breeding places of this species are of great importance wherever any attempt is made to reduce its numbers. The salt

marsh mosquito prefers brackish or salt water, but occasionally occurs in some numbers in fresh water. It never breeds in any numbers in localities where small fish or fiddler crabs occur, and ideal conditions are found in puddles and ditches, where there are no enemies, and particularly in holes and hollows on flats covered only by unusual tides or during storms. The flood of water hatches the eggs, and the pools remaining swarm with larvae a day or two after the deluge. The prolificacy of this species is strongly illustrated by Mr Viereck's estimate of 10,600,000 larvae occurring in a pool containing some 1894 sq. ft. This species does not breed on areas flooded by normal tides, or among grass or cattails, where there is considerable shade.

Culex discolor Coq.

Pl. 46, 48, fig. 4, 5 respectively

This is a yellowish brown, moderate sized mosquito with body mottled and variegated with brown, the legs and beak banded and the wings spotted, according to Dr Smith.

Description. The original description follows:

Palpi with a cluster of white scales at the apexes, upright scales of occiput yellow, whitish cross bands of abdomen prolonged forward in the middle, crossing or almost crossing the segments, scales on posterior side of front and middle tibiae and on anterior side of the hind ones almost wholly pale yellow, first tarsal joint bearing many yellow scales, black and yellow scales of wings not evenly distributed, the black ones forming a distinct spot at forking of the second vein with the third, another on upper branch of fifth vein at the hind cross vein, and a third on the apical third of the last vein, remaining scales of this vein wholly yellow; length 4 mm.

The larva according to Dr Smith is from ¼ to about $\frac{5}{16}$ inch in length and is yellowish brown in color. The head is almost as large as the thorax, being a little excavated before the antennae. The latter are white, almost as long as the head, thickest near the middle and with a double curve, the tips pointing outwardly. The tuft of a dozen hairs, well before the middle, does not reach the tip. The mandibles are peculiar in that they have but one dorsal spine. The comb consists of five to eight scales attached to a narrow band like a fringe and not directly to the skin. Each

scale is oblong with setose sides, two long spines at the angles and a very long central process. The air tube is small, about three times as long as wide, with two curved spines at the apex and an unusually large tuft below the spines. Pecten consists of from five to eight spines each bearing two to four very long, slender teeth. The anal gills are twice as long as the siphon, taper to almost a point and are well provided with tracheae.

Habits. This species is abroad in New Jersey the latter part of June, in July and early August. Mr W. P. Seal, who took the larvae at Delair N. J., states that they are rare and have the habit of remaining below the surface and feeding at or near the bottom. Dr Smith states that the larva has a peculiar habit of resting on the bottom, back down, with the antennae pointing upward and mouth brushes in constant motion. A single larva was also received by Dr Smith from Mr Brakeley, who took it at Lahaway N. J.

Culex jamaicensis Theo.

Pl. 44, fig. 2

This mosquito may be separated from the closely allied C. sylvestris by the shorter petiole of the submarginal cell, it

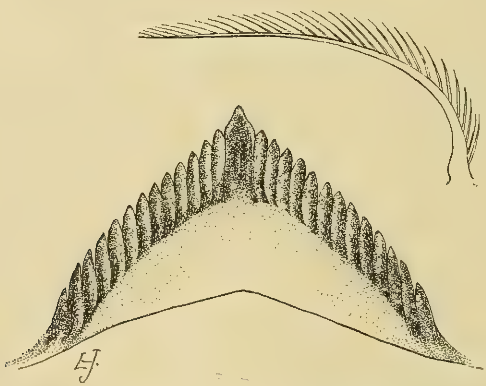


Fig. 36 Labial plate of Culex jamaicensis, with hair from same much more enlarged

being one third or less than one third as long as the cell. In other respects it agrees very much with the above named species.

Description. The larva has been described by Dr Dyar, who states that it has a round, flat head, narrow anteriorly, the anten-

nae long, slender, uniform, with the outer two thirds black, middle tuft slight, often folded and invisible. The air tube is brown, sub-

Fig. 37 Comb of C. jamaicensis

fusiform, about three times as long as wide, with a normal pecten, comb with only a few scales, each with a dentate, platelike base

Fig. 38 Middle spine of comb of C. jamaicensis

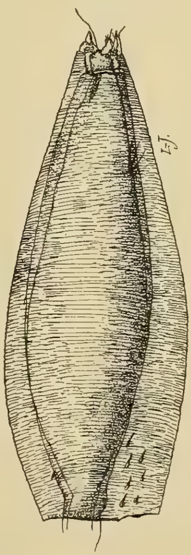


Fig. 39 Air tube of C. jamaicensis

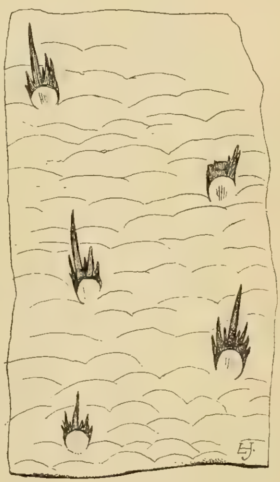


Fig. 40 Pecten of C. jamaicensis more enlarged

[fig. 37]. The labial plate and posterior extremity of the larva are also shown [fig. 36, 42].

Life history. The life history of this insect has been partially worked out. Dr Grabham states that the eggs are laid singly, and Professor Herrick found that the larvae invariably appear in pools within 12 hours after their formation by rain. This led him to believe that the eggs are deposited on the mud and hatched when soaked by rain, and the correctness of this conclusion is further substantiated by Dr Smith's observations on C. sollicitans. The young larvae were first met with by Professor Herrick, in an

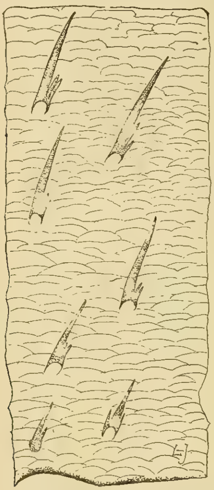


Fig. 41 Pecten of another larva equally enlarged

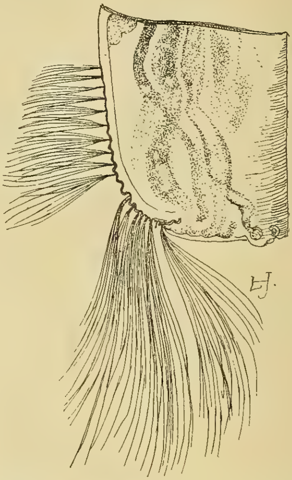


Fig. 42 Last segment of larva of Culex jamaicensis

open sewer drain, though later he more often found them in rain water pools, and his attention was attracted on account of their large size as compared with those of C. fatigans. The larvae frequently rest in a nearly horizontal position, much resembling Anopheles in this respect. Professor Herrick states that, when the larvae first rise to the surface they assume a position very similar to that of most species of Culex, but after a few moments, if left undisturbed, there is a slight jerk and the body quickly assumes an approximately horizontal position, the head being on a level with the surface of the water. He observed that the body after a few minutes, instead of lying nearly horizontal, as does that of Anopheles, hangs suspended like a piece of slack

rope, between the head and the respiratory tube and considerably below the surface of the water.

Distribution. This species has been listed from Jamaica by its describer, is abundant in Mississippi according to Professor Herrick, was obtained by Dr Dyar in a mud pool of rain water at Cabin John Md., has been sent to this office in the larval state from Staten Island, and taken by Dr Smith in New Jersey.

Culex taeniorhynchus Wied.

Small salt marsh mosquito

Pl. 4, 5, 18, 33, 42, 53, fig. 5; 1; 2, 3; 1; 1; 1 respectively

This coast species occurs in the same situation as the salt marsh mosquito, and on account of its banded proboscis [fig. 43],

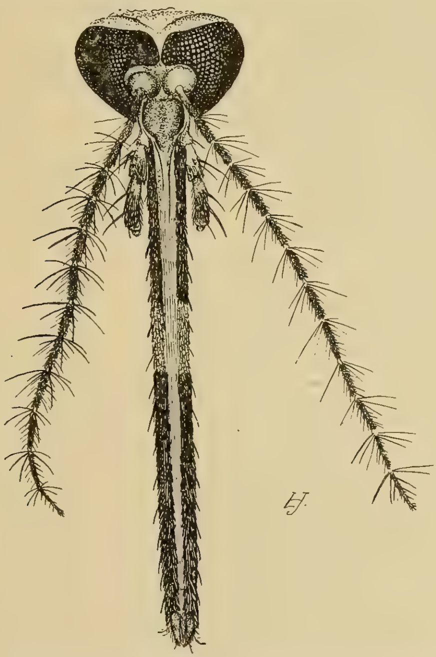


Fig. 43 Head and appendages of Culex taeniorhynchus showing white band on the beak

may be confused with it. This form more frequently haunts patches of woodland and may be recognized by the absence of the yellow stripe in C. sollicitans, while the basal bands of the abdominal segments are clear-cut, of a more uniform width and nearly or quite white.

Description. This larva has rather stout, dark tipped antennae with the tuft at the middle. Labial plate triangular with 21 or 23 teeth. The comb consists according to Dr Smith of 16 to 24 somewhat spatulate scales bearing a row of coarse setae, the longer ones at the apex. The air tube is very short, about one and one fourth times as long as broad with about 15 closely set pecten teeth with three to six or seven minute serrations on each side.

Dr Dyar states that the larva differs from C. sollicitans, by its shorter tube and the differently shaped teeth of the lateral comb.

Distribution. This appears to be a widely distributed form, since it has been recorded by Theobald from New Amsterdam, British Guiana, St Lucia, Florida, Honduras and Brazil, and it also occurs rather commonly in New York and New Jersey.

Life history and habits. This species probably passes the winter in the egg stage, in mud or at the base of grasses, in the same manner as C. sollicitans, since Dr Smith has bred it from eggs in the same piece of sod, and he states that the two species have the same habits, having reared adults of both, without previously suspecting that he was dealing with two insects.

Culex confinis Arrib.

This species has been listed from New Jersey by Dr Smith, who took it at Delair, July 10, and at New Brunswick, Aug. 3. It very probably occurs in New York State, and the following description by Theobald should prove of service in its recognition.

Very like Taeniorhynchus taeniorhynchus Arribalzaga but of smaller size and darker color, while the band on the proboscis is broader, but differs especially in the form of the wing scales. The broad white proboscis band extends from near the base to the middle; legs fuscous, fore femora sparsely decorated with scattered white scales, with a narrow white band a little before the apex; tibiae speckled white externally, uniformly colored inside; knees white; fore and mid tarsi with the first three, and the hinder with four, or all the joints with basal white bands; metatarsi distinctly shorter than tibiae. Abdomen dark fuscous, with coffee-colored scales above and narrow whitish bands; grayish below.

Length, 4.5 to 5 mm.

Habitat, Chaco in Formosa, Argentina.

Culex annulatus Schrank.

This mosquito may be easily separated from others having banded tarsi, by the broad band on the posterior tarsi.

Distribution. Dr Howard has recorded this insect from New Bedford Mass., Lincoln Neb., Santa Fé N. M., Stanford Cal., and Logan, British Columbia. It has also been recognized by Mr Ludlow at Fort Baker Cal. It appears to be widely distributed in this country, specially as it has also been reported from Mexico. Theobald states that this species is common throughout Europe, from Scandinavia to Italy, and also occurs in India.

Giles states that this large gnat is believed by Ficalbi, to feed only on the juices of plants, and he thinks that it does not attack man or animals.

Culex canadensis Theo.

Woodland pool mosquito

Pl. 5, 18, 19, 34, 42, 50, fig. 3, 4; 4; 3; 1, 4; 2 respectively

This comparatively large, rather handsome mosquito may be easily recognized by the last segment and each extremity of the other segments of the tarsi on the posterior legs being white. The petiole on the first submarginal cell is about two thirds its length, a character readily separating this species from C. atropalpus, which according to Coquillett has the petiole less than one half the length of the cell. The claws are all unidentate in specimens received from Theobald. This mosquito is at no time very abundant.

Description. The eggs according to Dr Dyar are laid singly, not adherent, fusiform, with ends rounded, black. The full grown larva has a pale brown head, with antennae brownish throughout, though darker on the outer third, a slight tuft a little before the middle. The air tube is conical, tapered, about two and one half times as long as wide, with two rows of pecten at the base. The comb consists of a triangular patch of small scales over three rows deep. Dr J. B. Smith states that the larva of this species is associated with that of C. cantans, which it resembles so closely that the two are not easily separated. We have bred this species, from woodland pools where it was associated with C.

canadensis, C. impiger, C. cinereoborealis and Aedes fuscus.

Distribution. This species was described from specimens received from DeGrasse point, Lake Simcoe, Ont. We have taken it about Albany and at Poughkeepsie. Dr Smith records it from New Jersey, and it is very common at Center Harbor N. H. according to Dr Dyar, who also met with it rather abundantly early in the season in British Columbia.

Life history and habits. Dr J. B. Smith states that the eggs are laid in the mud of dried up pools or in the pools themselves, sinking to the bottom in the latter case. The larvae hatch in New Jersey in January or February, often when the pools are covered with ice, and grow slowly, maturing and transforming to pupae late in April. The adults emerge during early May, and of the eggs laid by them only a portion seem to develop, because the second brood is smaller than the first and so on, and while larvae and adults are found throughout the season, they are stragglers and simply supply eggs for another year. Almost every low swampy woodland and nearly every pool swarms in April with the larvae of this species. Many of the pools dry up by the time the insects mature, and remain so till the following spring; nevertheless larvae again appear with the approach of warm weather. Dr Smith states that this is the earliest and latest occurring mosquito in New Jersey, and that it never becomes a nuisance in towns or houses, even though the latter be only a few rods from a pool. It seems as though the larvae of this species must hibernate in New York State, since they are of considerable size when they first appear in the spring along with other aquatic forms. Adults are on the wing about Albany in early May.

This species breeds by preference in woodland springs, pools or ditches carrying spring water.

Culex onondagensis n. sp.

Pl. 5, 17, fig. 2, 3 respectively

A specimen of this mosquito was taken in the vicinity of Lake Onondaga, Syracuse, Sep. 19, 1904, and as it differs so markedly from previously known forms, it is described herewith.

Antennae dark brown, sparsely clothed with fine whitish hairs, with sparse basal whorls of dark brown hairs on the segments, basal one brown, clothed internally with yellowish scales. Palpi, short, dark brown, with a few silvery white scales toward the apex. Apical portion of proboscis dark brown, basal part lighter with a few whitish scales. Occiput rather thickly clothed with yellowish and silvery scales, with a few black ones interspersed. Prothorax ornamented with a thick covering of golden yellowish scales, becoming grayish posteriorly (in the specimen this portion is somewhat rubbed). Scutellum similarly clothed and with no long setae. Halteres capitate, basal and apical portions fuscous. Pleura brownish, clothed with rather thick irregular patches of whitish scales. Abdomen dark brown, with a distinct broad median and somewhat broken lateral stripes of silvery gray scales slightly tinged with yellow. Basal bands of first and second abdominal segments somewhat indistinct, those of the third and fourth well marked, the dorsum of the remaining segments nearly covered with silvery white scales. Ventral surface sparsely clothed with silvery gray and yellowish scales. Femora and tibiae mostly yellowish with somewhat brown scales, which are flecked where thick with white. Fore and mid tarsi brown with apical white rings, hind tarsi with the apex and the extremities of the segments distinctly ringed, except the distal of the fourth, fifth snow white. Claws unidentate. Wings hyaline, clothed with intermixed brown, straw yellow and colorless scales, the narrow long ones mostly transparent. Petioles of the first and second fork cells about three fourths the length of their respective cells.

Culex atropalpus Coq.

Pl. 5, 6, 19, 32, 44, 55, fig. 5; 1; 2, 3; 1, 2; 5; 3 respectively

This mosquito resembles C. canadensis, though it may be separated from it by the length of the petiole of the first submarginal cell, as given above. This species has been recorded from several localities near New York State, and Prof. G. H. Hudson has taken it near Plattsburg N. Y.

Description. The egg has been described by Dr Dyar, as black elliptic with ends abruptly narrowed. They are deposited in groups, adherent to the surface on which they are placed. The full grown larva has a dark brown, nearly black head, the antennae are slender, small, uniform, with the tuft at the middle of the joint reduced to an inconspicuous hair. The air tube is short, not over twice as long as broad, slightly tapered, with double posterior pecten, a small tuft and several pecten teeth beyond the tuft. The comb consists of a long triangular patch of small scales about five rows deep. Dr Dyar states that this larva resembles that of C. canadensis, but the tube is shorter, the anal plate smaller, and the anal finger-shaped processes contain conspicuous tracheae.

Distribution. This species was described from specimens received from Virginia, Maryland, Pennsylvania and New Hampshire.

Life history and habits. Dr Dyar has met with larvae in small pools in the flat surface of a rock beside a stream on the side of Mt Ossipee N. H., and he adds that it did not occur near Center Harbor, where there were no rock pools. It was also found breeding abundantly in water-filled potholes on the edge of the Potomac river, above Plummers island Md., and was associated with C. territans, as in New Hampshire.

Culex dyari Coq.

Pl. 10, 21, 35, 43, 54, 55, fig. 1, 4, 1, 4, 1, 4 respectively

This mosquito has the tarsi ringed at the base, and simple claws, according to Coquillett, which readily separates it from others in this group, unless it be C. jamaicensis, from which it may be distinguished in the same manner as C. sylvestris. This form was taken by Dr Dyar, at Center Harbor N. H., and it would not be surprising if it was also found in New York State.

Description. This larva according to Dr Dyar has a rounded, pale brown head and stout antennae, the tuft at the outer third and the part beyond, smaller; strongly infuscated at tip, narrowly so at base, the center of the joint broadly pale whitish. Air tube about four times as long as broad, tapering rather abruptly beyond the middle, the tip not tapered. Basal pecten small,

double, approximate, not followed by hair tufts. Anal segment completely ringed; chitin darker and covered with numerous little spines, dorsally; pierced ventrally by seven little holes for a series of tufts that precede the barred area. Brush and tuft normal. Comb, a large patch of numerous small scales many rows deep. He figures about 10 rows composed of over 80 scales. Pupa normal, with funnel-shaped air tubes.

Life history and habits. Larvae were obtained by Dr Dyar in a cold permanent spring, and he is of the opinion that there is only an early spring brood, the species hibernating in the egg. Dr Dyar has also met with this species in British Columbia, where it is early and by no means common. He found one larva in a slow cold stream in the woods, May 29; it pupated at once, indicating that the breeding season had practically passed.

Culex territans Walk.

Little black mosquito

Pl. 6, 19, 20, 34, 43, fig. 2, 3; 4; 1; 1, 2; 6 respectively

This rather common, small mosquito has unbanded tarsi, and may be easily recognized by the cross band of whitish scales at

Fig. 44 Labial plate of Culex territans

the apex of the abdominal segments. It is widely distributed in the State, having been taken by us at Poughkeepsie, Karner and

Elizabethtown, in which latter larvae occurred in a pool with numerous small polywogs. The larva differs from all others in the enormously long, slender air tube [fig. 45] and by the broad head with prominent antennae. The latter are black at the tip and have a tuft of long hairs a little beyond the middle. The peculiar labial plate is also illustrated [fig. 44].

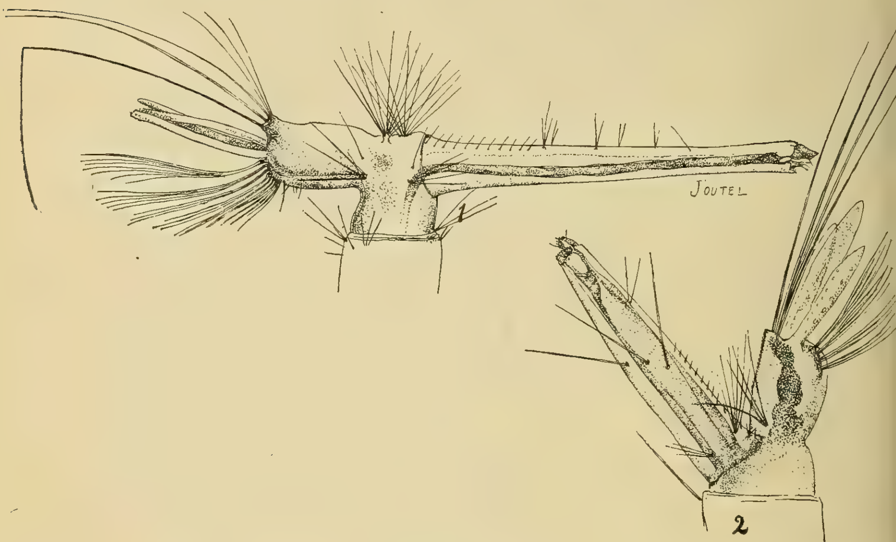


Fig. 45 Air tubes and anal appendages; 1 C. territans, 2 C. restuans

Distribution. This species is a rather common form in New York State, likewise in New Jersey and New Hampshire, according to Messrs Smith and Dyar. The latter has also taken it in British Columbia, and it is probably widely distributed in the northern United States.

Life history and habits. We have found it breeding in many places throughout the summer, and Dr Smith states that the larvae occur almost everywhere, in running or stagnant waters, fresh or brackish, though he has not found them in real foul or salt water. Dr Dyar states that the larvae prefer cold water, and that he took the same in a cold spring some 20 feet in diameter, and that they were not found in a warm, scummy

pool which yielded other species freely. He adds that in New Hampshire larvae occurred in every suitable pool, and after the middle of July they were the most abundant Culex larvae to be found, being present throughout the summer. Dr Dyar obtained some eggshells, which he believed to belong to this species, from a pool full of C. territans larvae. They were on the surface of the water in little boats composed of three or four eggs, each adhering by their flat sides, the mass floating sidewise on the water. They were so minute that a lens was necessary to ascertain their true character. He states that the life cycle occupies about three weeks, and that breeding is continuous as with C. pipiens, the winter probably being passed as adults.

Dr Smith states that this little mosquito is rarely troublesome in the early part of the summer, but sometimes late in the season it seems to become possessed with a furious desire for blood. At such times it forces its way through the netting of window screens, endeavors to find openings around them, or works up between the windows if they are imperfectly closed. This lasts for a short time and then the mosquitos suddenly leave. It is somewhat of a puzzle to account for their appearance in such numbers. This form is seldom recognized in house captures, since when collected in alcohol it has proved almost impossible to separate it from C. pipiens.

Culex lazarensis Felt & Young

Pl. 6, 20, 35, 43, 51, fig. 4, 5; 2, 3; 2; 3 respectively

Pupae of this well marked, beautiful species were taken in a deep, cold mountain pool at Elizabethtown N. Y., June 9, adults emerging the 10th. Larvae occurred at Karner N. Y., May 3.

Description. Occiput and thorax thickly clothed with golden yellow scales except for a narrow median dark brown line and on the thorax a broad submedian brown line on each side, all interrupted at the posterior fourth. More laterally and near the posterior end of the submedian stripes there is on each side a short, broader stripe. The golden vestiture is interspersed with scattering long, black hairs. Pleura clothed with patches of golden yellow and whitish scales. Abdomen dark brown or black, with broad, basal white bands, specially in the male, slightly continued

on each side, particularly in the female. Legs dark brown except the yellowish white coxae, inner side of femora and posterior side of the tibiae; tip of femora clothed with yellowish white scales.

Fig. 46 Unequal claws of Culex lazarensis

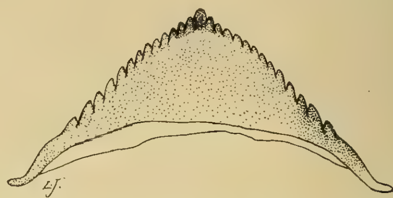


Fig. 47 Labial plate of C. lazarensis

Ungues unidentate. Wings hyaline, veins clothed with rather long scales; posterior cross vein about its own length from mid cross vein; petiole of first submarginal cell about one third the length

Fig 48 Comb of C. lazarensis

of the cell, that of the second submarginal cell about equal. Length of body $\frac{3}{16}$ in.; wing spread, $\frac{3}{8}$ in. Coloration nearly the same in both sexes.

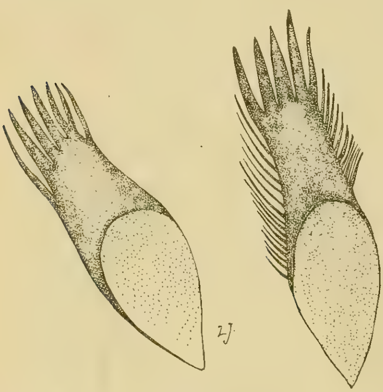


Fig. 49 Two comb scales of C. lazarensis

Female. Antennae clothed with sparse gray hairs. Palps brown, frequently well sprinkled with white scales, short, about one fifth the length of the long, brown proboscis. Abdominal cross bands decidedly narrower in the middle and well prolonged laterally, ventral surface suffused with white scales. Terminal segment not marked and ovipositor acute at the tip.

Male. Plumes of the white banded antennae, grayish. Palps very long, slender, and clothed with purplish brown scales. White abdominal bands very broad, covering nearly the basal half

of the segment, and with a slight median and lateral prolongation. Under surface of abdomen sparsely clothed with white scales, posterior fourth of segments brown. Basal segment of clasp stout, distinctly clubbed and somewhat lobed apically, bearing a long, slender, curved segment tipped with a stout spine. Ungues unidentate, except outer claw of fore leg, which is simple; tooth on inner claw almost capitate.

Described from many bred specimens, including several reared from isolated larvae.

Larva. Nearly ½ inch long when full grown, frequently greenish, turning to a slaty color after death. Antennae slightly darker at the tip, nearly straight, tapering uniformly and with tuft at the basal third, tip bearing one very long and two medium sized, slender processes, one shorter, much stouter, almost conical process and a very stout, knoblike remnant of a segment. Labial plate triangular, with about 27 fine teeth. Compound, finely spinose hairs on thoracic segments, usually simple ones on the abdominal segments. Comb

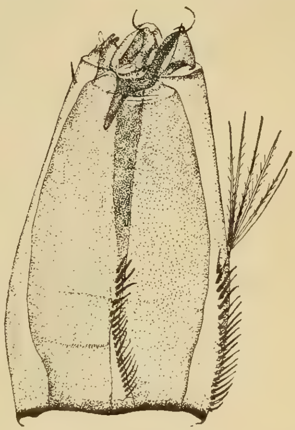


Fig. 50 Air tube of C. lazarensis

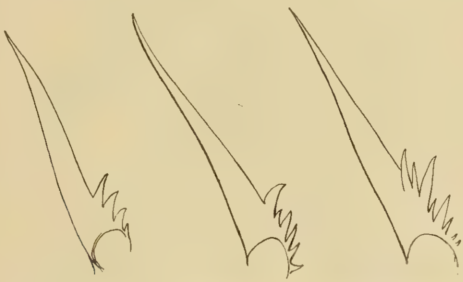


Fig. 51 Pecten teeth of C. lazarensis much enlarged

consisting of a triangular patch composed of about 60 rather stout scales, each tipped with about four to seven stout, equal spines. Air tube short, a little over twice as long as broad, slightly swollen at the basal third, bearing a double row of posterior pecten, each row with about 20 short, black, stout spines, usually with two well marked teeth at the extreme base. A compound hair occurs near the extremity of each row of pecten. Barred area short, on the posterior half of the anal plate and composed of only about 12 bars, each bearing a compound hair. Anal gills slender, acute at the tip.

Culex cinereoborealis Felt & Young

Pl. 7, 20, 21, 26, 36, 45, 52, 55, fig. 1, 2; 2; 1; 4, 1; 1, 5; 1 respectively

We have been unable to refer this form to any described species. It is closely allied to C. n e m o r o s u s Meig., though Theobald's description does not permit its reference to that species.

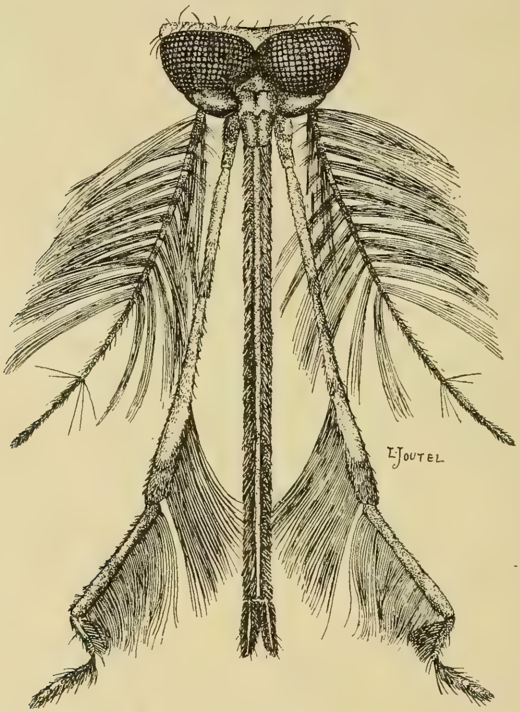


Fig. 52 Head and appendages of Culex cinereoborealis

Description. Thorax brownish gray, with central portion browner; abdomen brown, with basal white bands expanded at the sides; legs dark brown; coxae pale; femora light beneath; ungues unidentate in female, unequally toothed in male. Length, 7 mm; wing spread, 6 mm.

Fig. 53 Tarsal claws of male, C. cinereoborealis

Female. Brownish gray; proboscis long; palpi dark brown with base lighter than tips; occiput with white, narrow, curved leaflike

scales at center, broad truncate ones at the sides; numerous upright, narrow, forked, yellowish or dark scales are interspersed

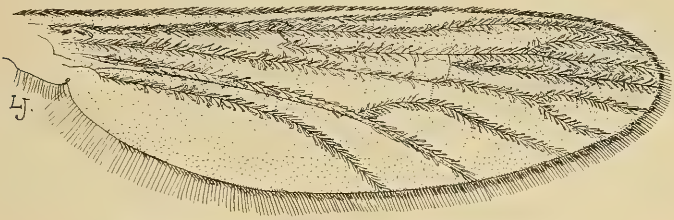


Fig. 54 Wing of female, C. cinereoborealis

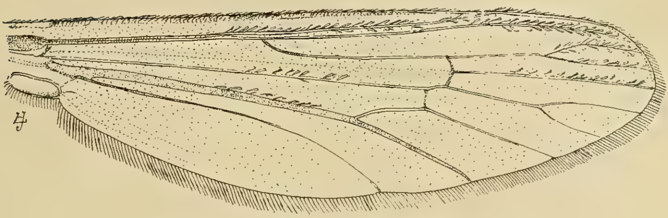


Fig. 55 Wing of male, C. cinereoborealis

among the others; black bristles extend forward with a few yellowish ones on the median line; antennae dark brown, base of first

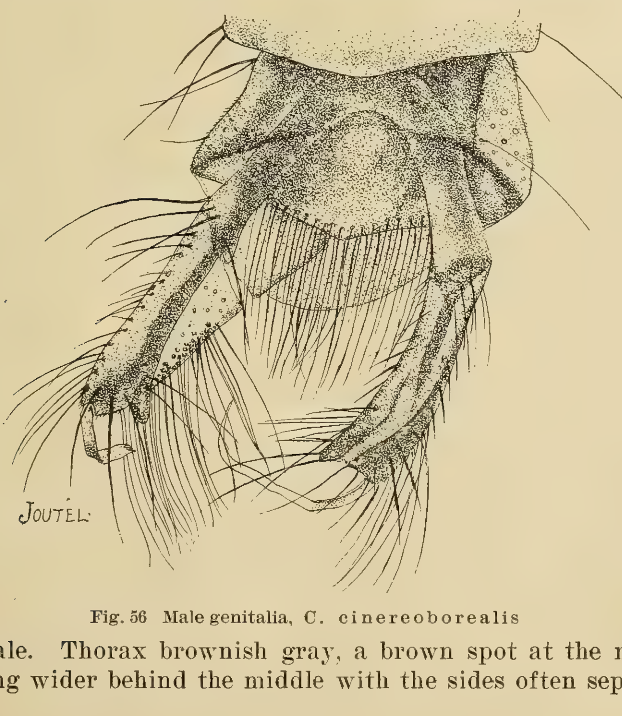


Fig. 56 Male genitalia, C. cinereoborealis

joint pale. Thorax brownish gray, a brown spot at the middle, becoming wider behind the middle with the sides often separated

from the central part by a narrow white line, lighter at the sides, with yellowish or golden scales. Pleura thickly clothed with white scales. The denuded thorax shows a median narrow brown line bordered with a lighter almost plumbeous one on each side. Abdomen brown, with a broad white band, somewhat expanded laterally, at the base of the segments. Yellowish white scales are scattered over the abdomen, while clusters almost form a median stripe, which is more apparent in bred or unabraded specimens. Ventral surface clothed with white scales. Legs, dark brown;

Fig. 57 Comb of C. cinereoborealis

femora yellowish, lighter beneath and almost black at apex. Anterior and mid tibiae lighter beneath, posterior tibiae show dark purple reflections in sunlight. Tarsi unicolorous, almost black; ungues unidentate. Wings large, thick, venation strongly marked; petiole of the first submarginal cell almost as long as cell; posterior cross vein less than its own length from the nearly equal mid cross vein.

Male. Head, similar in color to that of female; the antennae and palpi uniformly brown; thorax with brown spots more extended, more golden or yellowish scales, and with fewer white scales laterally and on the pleura. Abdomen more slender than in the female; basal bands narrower, with very few scattered yel-

lowish scales, numerous long flying hairs becoming quite dense at the apex. Legs long, same color as female; first joint of posterior tarsi almost as long as tibiae; posterior ungues equal, unidentate; the fore and mid feet bear one large claw with two teeth and a smaller one with one tooth. Wings longer and narrower than in the female; petioles of the first and second submarginal cells longer than cell, posterior cross vein about its own length from the mid cross vein.

Fig. 58 Comb scale of C. cinereoborealis

Larva. Length about $\frac{5}{16}$ inch; head light or yellowish brown, widest just behind the black eyes; antennae nearly straight, almost cylindric, slightly darker at the somewhat enlarged base and with a scanty tuft arising at the basal third. Labial plate broadly triangular, with 25 fine teeth. Thorax, lateral angles somewhat marked and each bearing a group of compound, finely barbuled hairs. A similar group also occurs at the anterior angle which is less sharply defined, and also on the dorsal surface. Hairs of the body mostly simple, those on the first and second abdominal segments compound and weakly barbuled. Comb of the eighth abdominal segment consists of 14 to 16 scales, each having a somewhat spatulate base and terminated by a stout spine, at the base of the latter on either side is a much smaller spine followed by a series of still smaller, weaker ones. Anal segment, with a broad dorsal plate extending nearly to the ventral line but not inclosing the segment. Air tube is about two and one half times as long as broad, tapering rather gradually to the apex, with two posterior pecten, each consisting of about 18 spines closely placed together and four others at a much greater distance. Each pecten tooth is stout and with one or two denticulations; dorsal surface of the air tube with a double row of hair tufts, each consisting of about four tufts composed of a pair of weakly barbuled hairs.

Life history and habits. This large species is a frequenter of woodland pools in the vicinity of Albany, where it occurs in association with C. canadensis, C. impiger, C. cantans

and Aedes fuscus. We believe this species winters in the larval form, since with the opening of the spring and appearance of life in the various pools, only nearly full grown larvae were to

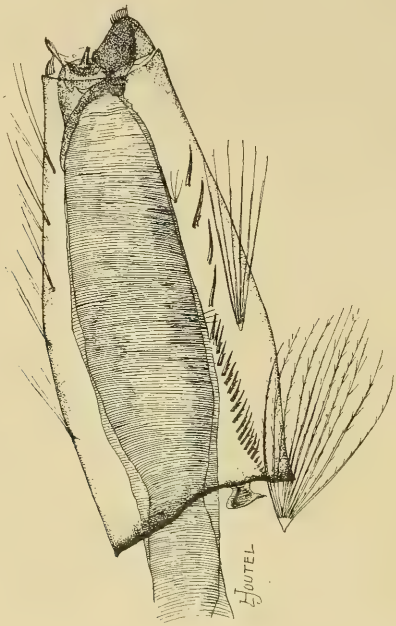


Fig. 59 Air tube of C. cinereoborealis

be found. The adult insects appear from the early part to the middle of May.

Culex impiger Walk.

Pl. 7, 21, 36, 43, 52, fig. 3, 4; 2, 3; 1; 1; 1 respectively

This very common New York mosquito with a basal white band on the dorsum of the abdominal segments, may be readily sepa-

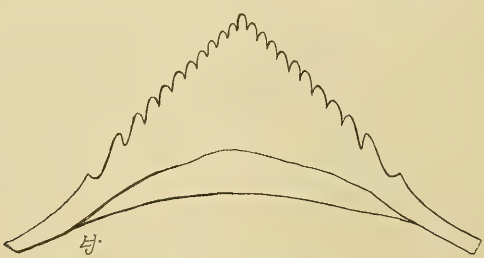


Fig. 60 Labial plate of Culex impiger

rated from C. consobrinus by the toothed claws. This species was met with in early spring as larvae frequenting woodland pools where it was associated with C. canadensis, C. can-

tans, C. cinereoborealis and Aedes fuscus, adults appearing in early May. It probably winters in the larval form.

Description. This is one of the two species in which the posterior cross vein of the wing is very close to the first cross vein. Theobald makes C. impiger a synonym of C. nigripes, but Howard states that the latter does not occur

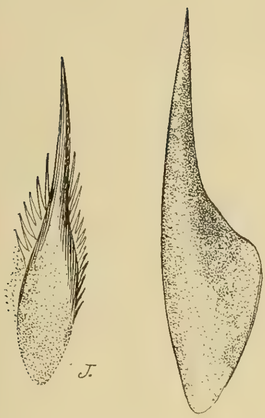


Fig. 61 Two views of comb scales of C. impiger

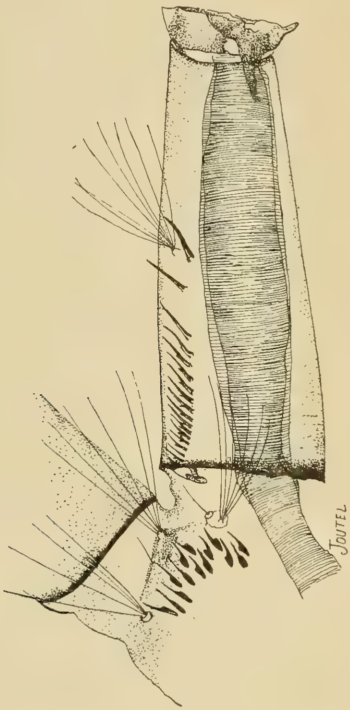


Fig. 62 Air tube of C. impiger

in this country or Canada. The male of C. nigripes has the abdomen covered by black scales, while the male of C. impiger has cross bands of light colored scales on the abdomen. Larva about $\frac{5}{16}$ inch long; head, rather dark brown; sides somewhat angular; antennae, fuscous at tip with a slight tuft arising at the basal third. Labial plate rather broadly triangular with 11 teeth on each side of the median one. Thoracic hairs finely barbuled and arising in groups of three or four; abdominal hairs more slender, some double, and all finely barbuled. The comb consists

of a somewhat triangular patch of about 14 scales, each with the finely setose spatulate base prolonged into a stout spine. Air tube three to four times as long as broad, slightly conical, in each row 15 to 18 pecten teeth, the distal two widely separate and all of the continuous row with one or more basal teeth.

Fig. 63 Pecten tooth of C. impiger

This larva was taken in a woodland pool at Karner, May 3, 1904, where it seems to be somewhat abundant.

Distribution. This species evidently has a wide distribution in North America, since it has been recorded by Dr Howard from several British Columbian localities and a number of states, occurring as far south as Georgia, the Isle of Pines and Jamaica, West Indies, and the city of Mexico, and it probably ranges across the continent, because Theobald lists it provisionally from California, and referring this form to C. nigripes, also lists it from Lapland; Greenland; the arctic circle generally; Cashmere, India; and Virgin bay, Alaska.

Culex consobrinus Desv.

Examples presumably of this species have been recorded by Dr Howard from the Catskills. He also lists it from a number of states, and if the species from various localities is the same, it evidently has a wide distribution, ranging from Canada south to Louisiana and across the continent. The female kindly lent us for study varies about the cross veins [pl. 9, fig. 1] from the following two, specially the first, and there are other differences.

Culex absobrinus n. sp.

Pl. 8, 22, 37, 45, 51, fig. 1, 2 ; 1, 2 ; 1 ; 4 ; 2 respectively

Larvae, first referred to Culex consobrinus Desv., were taken in a cold mountain pool at Elizabethtown N. Y., July 8, where they were found in small numbers. A few adults were captured in the same locality the latter part of August.

Female. Proboscis about as long as the abdomen, dark brown; palpi light brown, rather sparsely clothed with yellowish white scales. Antennae black, sparsely clothed with short, brown hairs and with several long, black ones at bases of joints. Eyes coarsely granulate, greenish. Occiput sparsely clothed by and margined anteriorly with white scales, and with a thick tuft of the same at the juncture of the eyes; numerous erect, scattering, black scales occur among the yellowish white ones. Thorax brown, clothed with a fine, appressed pile; a median line of dark brown or black scales, golden yellow anteriorly and terminating at the posterior third in an irregular, rather loose group of golden yellow hairs; a submedian line of golden yellow hairs bordered internally with long, black ones and extending anteriorly into a somewhat irregular patch. Anterior margin of thorax with golden and yellowish white scales, the lateral margin bordered by long, blackish hairs, and internally with a few yellowish white scales. Scutellum brownish, clothed apically with a row of long, brownish hairs and with a pair of submedian patches of whitish scales anteriorly; postscutellum brownish, naked. Pleura clothed with irregular patches of whitish and yellowish white scales. Dorsal surface of abdominal segments dark brown, with well marked, creamy white basal bands; under surface suffused with fine, creamy white scales. Wing veins dark, thickly clothed with dark brown scales; posterior cross vein less than ½ its length from mid cross vein. Legs light brown, with darker brown scales forming indistinct bands, there being lighter rings at the apex of femora and tibiae. The markings are too faint to be construed as bands. Claws simple. Petiole of first submarginal cell about ½ the length of the same, and that of the second over ½. Fringes and scales clothing the veins mostly dark fuscous, thick, scales very long, narrow. Fringe composed of scales of several lengths as in the pipiens group. Halteres capitate, stem and base yellowish, tip black anteriorly.

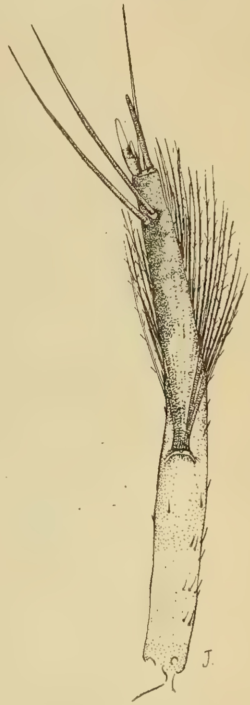


Fig. 64 Larval antenna of Culex absobrinus

Male. Palpi long, purplish brown, without conspicuous plumes; 4 segmented, the apical two joints being slightly larger

than the longer basal ones, the second longer than the first. Proboscis the same color, length and general appearance of the palpus. Antennae rather sparsely ornamented with brownish plumes, brown, each segment annulate with white. Eyes rather

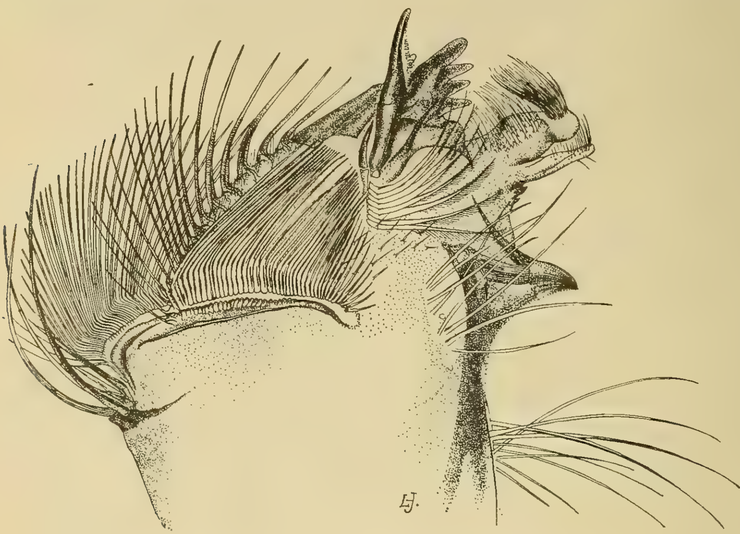


Fig. 65 Larval mandible of C. absobrinus

coarsely granulate, greenish black. Occiput rather sparsely clothed with silvery yellow scales, which form a distinct line on posterior border of the eyes, a sparse median tuft at their juncture, and also have a somewhat linear arrangement each

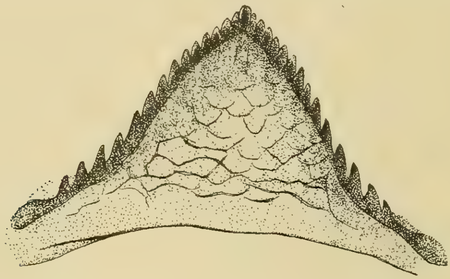


Fig. 66 Labial plate of C. absobrinus

side of the median line; erect black forked scales rather sparse. Thorax with a median line of mixed black, golden yellow scales, obsolete posteriorly. Humeri sparsely clothed with an irregular patch of golden yellow scales, with a few black ones intermixed. There is a submedian line of coarse hairs bordered outwardly by

golden yellow scales, and traces of similar sublateral ones near the base of the wings. Posterior portion of prothorax smooth, bordered anteriorly by an irregular patch of golden yellow scales, with black hairs intermixed. Scutellum crowned with long, black hairs and with somewhat irregular, obsolete, submedian patches of golden yellow scales; postscutellum smooth, slaty gray. Pleura sparsely clothed with irregular patches of

Fig. 67 Comb scale of C. absobrinus much enlarged

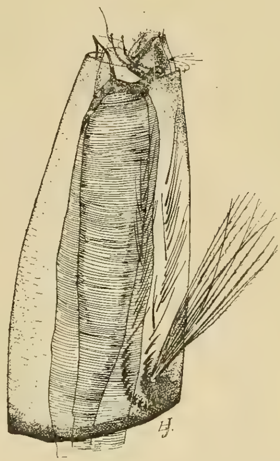


Fig. 68 Air tube of C. absobrinus

silvery yellow scales. Abdomen dark brown, with rather narrow, basal bands of silvery white scales; sparsely clothed, specially laterally, with slender, golden yellow hairs. Basal portion of clasp stout, thickly haired, yellowish brown; apical portion slender, uniformly curved, yellowish brown. Ventral surface brownish black, that of the second, third and fourth segments being sparsely clothed with silvery yellow scales, and each of the latter with a distinct basal band of the same color. Wings hyaline; anterior margin and first longitudinal vein rather thickly clothed with dark brown scales, others with lighter colored ones; fringe slaty gray. Petiole of first submarginal cell about equal in length to the cell, that of the second about one-fourth longer. Posterior cross vein less than its own length from mid cross vein. Halteres, basal portion pale yellowish white, apical portion capitate, dark brown. Coxae slaty gray, golden yellow apically. Legs dark purplish brown, with apexes of femora and tibiae clothed with golden yellow scales. Anterior

and mid ungues uneven, one claw bidentate, one unidentate, posterior simple. Posterior legs enormously prolonged; tarsal segments extremely attenuate and fragile.

Described from a freshly bred specimen July 14, 1904.

Larva. Antenna rather stout, curved, with a thick, well developed tuft of plumose hairs at its basal third and a pair of long, slender spines at the apical fifth, in addition to one long spine and two rudimentary, tapering processes at the apex. Labial plate subtriangular, with about 29 rather fine teeth, basal portion with distinct, rather coarse reticulations. Thoracic and anterior abdominal segments clothed with numerous stout, black, plumose hairs, the other abdominal segments bearing slightly compound, weakly plumose hairs. In addition, there are smaller groups of compound hairs. The comb consists of a triangular patch of about 60 scales arranged in five irregular rows, each scale with a brown, basal, somewhat spatulate enlargement and terminated by an expanded, nearly colorless tip bearing a series of rather fine subequal, apical spines, smaller spines extend on each side to the extreme base. Air tube about four times as long as wide, slightly inflated and with two rows of pecten at the basal fifth, each consisting of about 14 closely set teeth bearing at their bases one or two conspicuous processes; pecten extended by a well marked row of about 16 simple bristles reaching to the apical fifth of the air tube. There is a posterior pair of compound, plumose hairs at the base of the air tube. Ventral tuft short and consisting of about 14 well developed, compound hairs attached to the barred area, with three anterior. Dorsal tuft composed of a single, stout, compound hair and a pair of very long, slender, simple hairs.

Culex magnipennis n. sp.

Pl. 8, 22, 23, 37, 45, 51, 55, fig. 3, 4 ; 3 ; 1; 2;; 3 ; 1 ; 2 respectively

Larvae of this large and interesting species were taken in a shaded pool at Sodus Point N. Y., Aug. 25, adults emerging the 29th. The female is remarkable on account of her large wings with broadly rounded anal lobes.

Description. *Male.* Proboscis long, curved, yellowish, specked with black, tip jet black. Palpi four segmented, longer than the proboscis, not plumose; basal segment globose, second sparsely, third moderately, fourth and fifth rather thickly clothed with small, brown, appressed scales, a few longer, black, ventral setae on the apical portion of the third and fourth segments. Antennae black, basal segment reddish, subglobular; others ringed with white and bearing basal whorls of long, black hairs, except the two apical ones, which are very long, slender and sparsely clothed with yellowish white plumes. Eyes greenish, deeply emarginate. Occiput sparsely clothed with golden yellow scales, a distinct line occurring along the posterior margin of the eyes, forming a median tuft. Prothorax with distinct median and sublateral black lines, sparsely clothed with short, golden yellow scales, slightly thicker on each side of the black lines, lateral portions bearing longer, black setae. Pleura sparsely clothed with short, yellowish scales. Scutellum rather prominent, irregularly fuscous, bearing long, yellowish setae; postscutellum naked, yellowish, rounded. Halteres: basal portion irregularly expanded, yellowish, transparent, apical part capitate, fuscous. Abdomen brown, mottled dorsally with dark brown, nearly black scales; laterally there is an indistinct row of yellowish scales; antepenultimate segment irregularly mottled with yellowish scales. Ventral surface suffused with orange yellow scales. Coxae clothed with golden yellow scales; femora yellowish beneath, dark brown above, rather thickly mottled with yellowish scales. Tibiae and tarsi black, except that the former are sparsely mottled with silvery white scales. Ungues of fore and mid legs unequal, one claw bidentate, the other unidentate, posterior claws simple. Wings hyaline, sparsely clothed with brownish scales; fringe slaty gray; posterior cross vein less than its own length from mid cross vein; petiole of first submarginal cell about two thirds the length of the cell, that of the second about three fourths.

A rather large mosquito measuring about 5 mm, wing spread, about 10 mm.

Female. Antennae dark brown, sparsely ornamented with very fine, yellowish white scales, and with short basal whorls of long, black hairs; basal segment subglobose with an inner patch of whitish scales. Proboscis longer than the abdomen, light brown, tipped with dark brown and ornamented laterally and ventrally with whitish or yellowish scales. Palpi short, brown, second joint and apex of terminal segment rather thickly clothed with yellowish white scales. Eyes coarsely granulate, dark green. Occiput rather densely clothed with yellowish scales,

which form a line along the posterior margin of the eyes; erect black scales rather sparse. Prothorax light brown, with distinct, narrow, median and submedian lines, each bordered by a rather thick row of golden yellow scales; other portion of prothorax rather sparsely clothed with golden yellow scales and ornamented laterally with long, black setae. Pleura clothed with irregular patches of silvery white scales. Scutellum slaty brown, with median and lateral patches of golden yellow spines; postcutellum smooth, pinkish. Base of halteres semitransparent, pinkish, apical portion capitate, dark brown. Abdomen dark brown, profusely ornamented with orange and yellowish white scales in the form of broad, basal bands, the median portion being narrow and composed of orange scales, while the lateral portion extends almost the entire length of each segment and forms a nearly complete, lateral, yellowish white line; median and posterior portions of each segment dark brown with a few orange and yellowish white scales, the latter nearly covering the antepenultimate segment. Abdomen clothed laterally with long, silky, white hairs; ventral surface suffused with silvery white scales. Wings hyaline, clothed with dark brown scales, the fringe being a slaty gray and composed of scales of various length, as in C. pipiens, and the costa and subcosta flaked with silvery white scales. Petiole of first submarginal cell nearly one half the length of the cell, that of the second about three fourths. Posterior cross vein close to the mid cross vein and sometimes almost interstitial. Coxae whitish, semitransparent; under surface of femora and tibiae whitish, other portions dark brown flecked with yellowish white scales and with apical white bands; tarsi black, sparsely flecked with white scales, claws simple.

Described from a freshly bred specimen.

The larva of this species was found in association with those of Anopheles punctipennis, Culex territans and C. sylvestris. It was easily recognized in the water by its size and dark color, it being about as large as the larva of C. cantans or C. cinereoborealis, and occurred singly in water several inches deep, coming to the surface only after rather long intervals.

Antennae rather stout, slightly curved and somewhat enlarged at the base, apical portion fuscous; a well developed tuft of plumose hairs slightly before the middle; two long subapical, two long apical spines and a short, stout process on the tip. Labial plate broadly rounded, triangular, with about

25 coarse teeth; mandible very similar to that of C. absobrinus, figure 65. Thoracic and anterior abdominal segments clothed with numerous stout, black, plumose hairs, the larger abdominal segments bearing slightly compound, weakly plumose hairs. The comb consists of a triangular patch of about 40 scales arranged in about five irregular rows, each scale with a dark brown, basal, somewhat spatulate enlargement and terminated by an expanded, nearly colorless tip, bearing a series of rather fine, subequal, apical spines, smaller spines extending on each side to the extreme base. Air tube about four times as long as wide, slightly inflated and with two rows of pecten at the basal sixth, each consisting of about 14 closely set teeth bearing at their bases two or three conspicuous processes, pecten extended by a well marked row of 17 simple bristles reaching to the apical third or fourth. There is a posterior pair of compound, plumose hairs at the base of the air tube. Ventral tuft short and consisting of about 15 well developed, compound hairs attached to the barred area. Dorsal tuft composed of a very stout, compound hair and a smaller one with many more branches.

This larva closely resembles that of C. absobrinus and may be separated therefrom by the smaller number of comb teeth (which are also shorter and stouter), the greater number of basal processes on the pecten, and the decidedly different character of the labial plate. There are also other differences as will be seen by reference to the above description.

Culex restuans Theo.

White dotted mosquito

Pl. 9, 23, 38, 44, 53, fig. 2, 3; 2, 3; 1, 2; 3; 2 respectively

This species has been confused with C. pipiens, and according to Theobald's description may be separated therefrom by the spotted thorax, but in our experience this character is somewhat variable either on account of abrasion or nonexistence in some cases.

Description. Theobald states that the wing venation is almost exactly alike, but in specimens before us, the stem of the first

submarginal cell is from one sixth to one fifth its length in this form, while in C. pipiens it is but one seventh. This species may also be recognized by its light color, the whole body having a yellow tinge, and by the basal bands of the abdomen

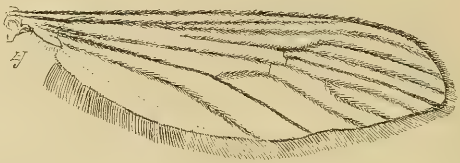


Fig. 69 Female wing of Culex restuans

being more uniform and straight. Perhaps the best character of all, discovered by Coquillett, is the short pale banding at the extreme ends of the hind tarsal joints, which is absent in C. pipiens.

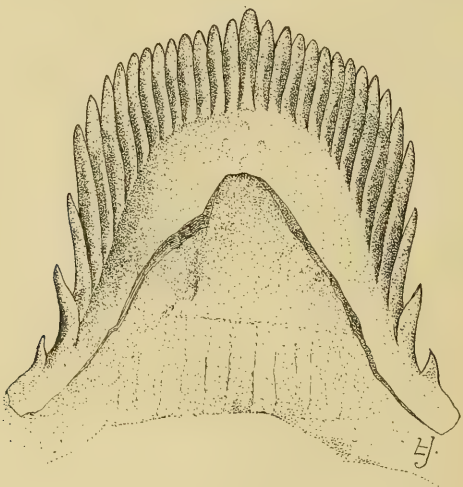


Fig. 70 Labial plate of C. restuans

The eggs according to Dr Dyar are laid in a large boat-shaped mass as in C. pipiens, adhering by their sides and standing perpendicularly to the water, the mass floating freely. The individual eggs are elliptic, fusiform, with sharply tapered ends.

The larva may be distinguished by its long breathing tube [fig. 45], at least five times as long as wide, and the presence of the antennal tuft before the middle of the joint, since other long

tubed larvae have the tuft at or beyond the outer third. The labial plate is shown at figure 70. The pale double pecten (each spine four or five toothed) is followed by a few long hairs, and the comb consists of a triangular patch of little scales four rows deep. Dr Dyar describes the pupa as normal, air tubes cylindric, curved, rather long and not funnel-shaped. This species has been carefully described by Johannsen.

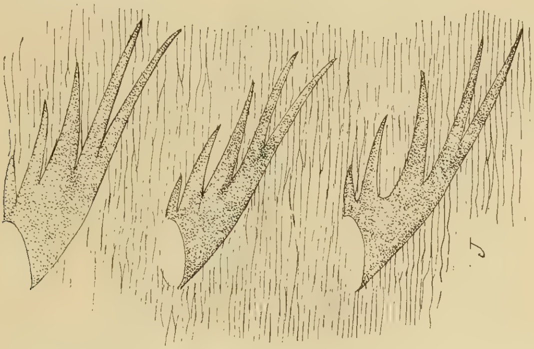


Fig. 71 Several pecten teeth of C. restuans much enlarged

Distribution. This species was described by Theobald, from Ontario, Canada, and has been taken by us in widely separated New York localities, notably, Adirondacks, Albany and Westfield. It was obtained at Center Harbor N. H. and Cabin John Md. by Dr Dyar, and at Lahaway N. J. by Mr Brakeley.

Life history and habits. Our own experience indicates that this larva is found in much the same situation as C. pipiens, except that we have not taken it in filthy water, it seeming to prefer an open barrel or vessel containing clear rain water. This is confirmed by Dr Smith's observations. We have also taken this species at Lake Placid, an elevation of 2000 feet, in a large hollow burned in a pine and partly filled with rain water. The same species was met with at Big Moose in a tub of rain water. Dr Dyar records taking it from cold spring pools in New Hampshire, though he states that it is not confined to such places. He has met with it in pools shaded by bushes, and even in rain puddles. He states that the larvae pass through four stages as usual, and that they may be found all summer and fall, and possibly may survive the winter in favorable situations.

Culex pipiens Linn.

House or rain barrel mosquito

Pl. 9, 23, 24, 26, 38, 44, 53, fig. 4, 5; 4; 1; 2; 3, 4, 5; 1; 3 respectively

This is the commonest mosquito about Albany, and undoubtedly throughout the State. It may be separated from others of this group by the very long first submarginal cell, and the abnormally short petiole, it being but one seventh the length of the cell.

Description. The larva has been described by Dr Dyar, who states that the head is rounded, full at the sides, pale; that the antennae are large and long, completely infuscated, or in pale specimens somewhat lighter at the base, a tuft being at the outer third of the joint and the part beyond more slender than the basal

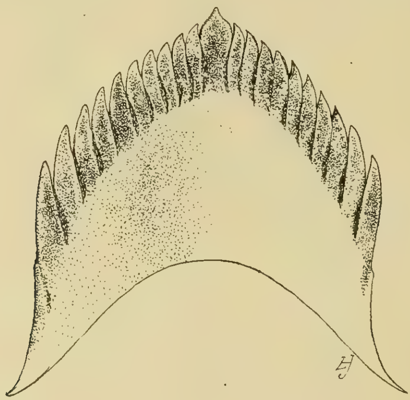


Fig. 72 Labial plate of C. pipiens

portion. The labial plate is as illustrated [fig. 72]. The air tube is four times as long as wide, strongly tapered at its terminal half, pale brown, with small, weak, double posterior pecten followed by several tufts of hair. The comb consists of a large patch of small spines in a low triangle about four rows deep. The different stages have been minutely described by Johannsen.

Distribution. This species appears to be widely distributed throughout the world, since Dr Marlatt records having met with it in such distant countries as Japan, China and Java, while Theobald states that it occurs in Europe generally, from Scandinavia to Italy, and in North America.

Life history and habits. This mosquito appears to love human habitations and may be found breeding throughout the warmer months in any open receptacle containing fresh water. One or two rain barrels are sufficient to produce millions of the pests, and in places remote from the seashore this or the preceding species are the ones most likely to cause annoyance on account of their abundance about habitations. The eggs are deposited on the water, hatch quickly, and the life cycle may be completed in about 16 days.

Culex abserratus Felt & Young

Pl. 10, 24, 45, fig. 2, 2, 2 respectively

The adult of this species is very close to C. impiger, while the larva has a general resemblance to C. serratus. It was

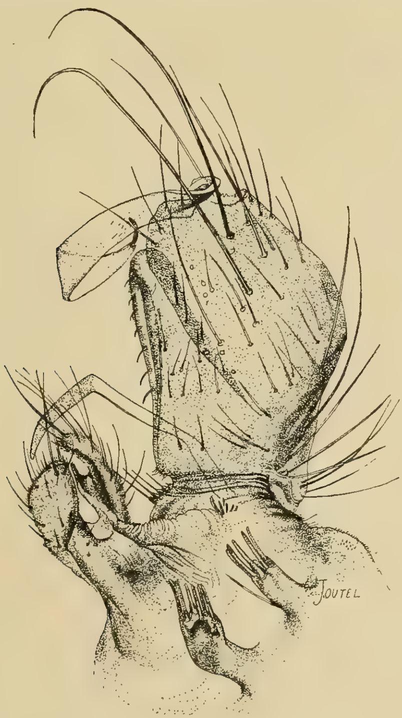


Fig. 73 Genitalia of Culex abserratus

bred June 14 from a larva taken in a cold mountain pool near Elizabethtown N. Y. June 9. A second larval skin was also met with in the collections but no other adult was obtained. It was

associated with C. lazarensis, C. cinereoborealis, Eucorethra underwoodi, and Corethra lintneri.

Description. Antennae thickly clothed with brownish gray plumes, that of the male annulate and of the female unicolorous. Basal segment globular, light brown, sparsely clothed with scattering white scales. Eyes deeply emarginate. Occiput sparsely and the thorax thickly clothed with golden yellow scales, except that the latter has a very narrow, median, dark line and a semicircular, lateral one on the posterior third. Abdomen dark brown, almost black, with broad, basal white bands, slightly prolonged laterally. Ventral surface uniformly suffused with whitish or creamy white scales. Coxae, base, apexes and inner face of femora, and to a less extent the posterior side of tibiae, creamy yellow; other portions of legs brown, with a sparse clothing of whitish scales. Claws unidentate. Wings, with almost fuscous veins well clothed with dark scales. Petiole of first submarginal cell about one third the length of cell; that of the second submarginal cell about equal, breadth of latter cell one third its length; posterior cross vein more than its own length from mid cross vein. Length of body about 5 mm; wing spread, 10 mm.

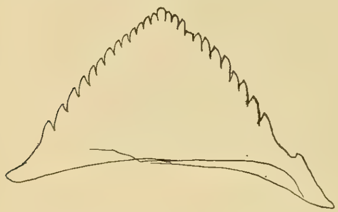


Fig. 74 Labial plate of C. abserratus

Described from a single bred, bisexual individual, the right side being male with the cephalic appendages largely female, while those of the posterior extremity are largely male. The male antenna is normally plumose, while that of the female has elongate segments sparsely clothed with long hairs. The male palp is well developed and tipped with a conspicuous mass of plumes as in normal specimens. The female palp appears to be normal for the other sex, is four segmented, basal one nearly globular, the distal three subequal, the third somewhat capitate at its apex and the fourth strongly constricted near its middle. Proboscis well

developed and about as long as the body. Basal segment of male clasp stout, irregularly curved, rounded. Apical portion nearly strap-shaped, describing almost a semicircle and with a curved,

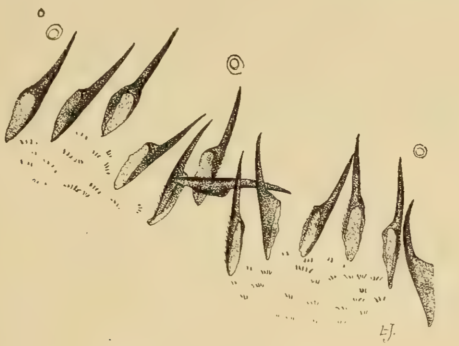


Fig. 75 Combs of C. abserratus, showing those of both sides

blunt spine apically. Harpe long, irregularly curved, pointed. Organs on opposite side poorly developed, distorted. At the extreme base slightly anterior of the basal segment of the clasp there is a pair of short, fleshy organs tipped with four or five stout spines. Ungues of the front tarsi on the male side unequal, all others and those of the female side equal.

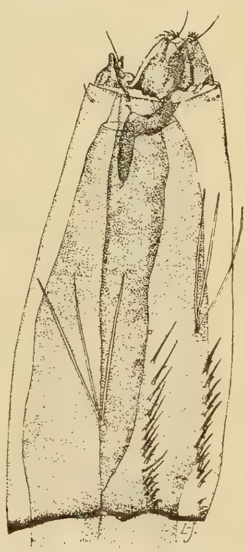


Fig. 76 Air tube of C. abserratus

Larva. Antennae rather stout with a slight basal enlargement tapering almost uniformly therefrom; tuft at basal third. Apex bearing one long and one medium, slender process, a smaller one and also a much stouter rudimentary segment. Labial plate rather broadly triangular, bearing 27 fine, triangular teeth. Thorax with compound, finely barbuled hairs; abdomen mostly with simple ones. Comb consisting of six or seven scales arranged in a curve, each with a large, finely setose, spatulate base and with a

large, apical spine. Air tube about three times as long as wide, tapering regularly, with double posterior pecten on basal third, each row consisting of from 12 to 15 closely set (except the slightly separate terminal three) stout, black spines, each bearing near the basal third one large and usually a smaller tooth. Barred area short, dense, bearing numerous long, branching hairs. Anal gills long, slender, uniformly tapering.

Culex nemorosus Meig.

This large species may be separated from others in the group, by the very long petiole of the first submarginal cell, which is longer than the cell itself. It has been recorded by Theobald, from Lapland to Italy and has been received by him from a number of Canadian localities. It should occur in New York State, though we have not met with it.

Culex salinarius Coq.

Unbanded salt marsh mosquito

Pl. 10, 24, 39, 43, 53, fig. 3, 4; 3, 4; 1, 2; 5; 4 respectively

This species was known under the name of C. nigritulus Zett. in this country till Mr Coquillett showed that it could not be identical with the European form and proposed the above name therefor. It is closely related to C. pipiens, but may be distinguished from it by the indistinct abdominal cross bands which are widest at the middle. It is also a smaller species.

This larva may be easily recognized, according to Dr Smith by its dirty white color and the very long, moderately stout air tube. The labial plate is broadly triangular with eight teeth on each side. It has double pecten, each tooth coarsely three spined, and scattered hairs beyond. The comb consists of a patch of about 40 narrow long fringed scales in three rows.

Distribution. This salt marsh form has been recorded by Dr Smith in association with C. sollicitans. We have taken it in small numbers in New York State.

Life history and habits. Dr Smith states that, though the larva may occur anywhere on the marsh, in brackish as well as fresh

water, it seems to prefer pools near the upland which are mostly formed by rains and by springs working down from the highlands. This form appears to hibernate as an adult and never gets far away from the edge of the salt marsh. Dr Smith states that the mosquitos hide wherever they can find shelter, by preference in cellars, and cites the case of a factory just at the edge of a marsh where thousands were found. It does not begin to appear till rather late, and very little is seen of it till June. The eggs are laid in boat-shaped masses similar to those of C. pipiens, hatch in the same manner, and unlike other marsh forms, it occurs also in the more permanent pools where other salt marsh species are not found.

Culex trivitattus Coq.

This is the first of a series in which the abdominal bands are wanting, though in some there are light colored hairs or reflections which give that appearance at first sight.

Description. This very distinct species is easily recognized by the two broad yellowish thoracic stripes on each side of the central dark brown one. It was described from Chester N. J., and we have taken specimens in association with Anopheles punctipennis at Bath-on-Hudson and also at Poughkeepsie N. Y.

Larvae of this species were taken in New Jersey in woodland pools on the hills back of South Orange. Adults occur in New Jersey during July, August and early September.

Larva. It has been characterized by Dr Smith as about 1/4 inch in length with a comparatively small head one third wider than long. The antennae are less than half the length of the head, sparsely set with rather large spines and tipped with one long and one short spine, a bristle and a stout articulated process. The tuft is just before the middle and is composed of several hairs. The comb consists of an irregular patch of 14 to 22 spatulate scales tipped with a large spine and bearing on either side long slender setae. The air tube is short, chunky, bearing a double row of somewhat curved pecten, each spine usually with two or three basal teeth.

Culex serratus Theo.

Pl. 44, 52, fig. 4, 4 respectively

This species is a moderate sized, well marked form, and may be recognized by the prominent silvery white stripe in the middle of the thorax.

Description. The larva has a dark brown head, somewhat flattened, tapering anteriorly. The antennae are darker at the tip, not quite half the length of the head, and are terminated by four articulated spines, and the tuft of hair arises near the middle. The triangular labial plate has 35 fine teeth. The air tube is about twice as long as wide, a little dilated before the middle, with posterior pecten, each consisting of seven to nine spines minutely toothed near the middle and with a conspicuous terminal tuft. The comb is composed of five somewhat spatulate scales arranged in a short curved line.

Distribution. A larva of this species was received in September from J. R. de la Torre Bueno who took it in a fresh-water pool on Staten Island. This species has been recorded by Theobald, from several South American localities, and Dr Smith states that it ranges the full length of the state of New Jersey.

Life history and habits. Larvae and pupae of this species were taken by Dr Smith in a low swampy woodland in New Jersey, July 29, and adults began to appear the next day. A few larvae were also taken in early September, and adults were met with near dried up pools the middle of the month. These pools became filled with water and produced larvae and pupae Sep. 30, and adults emerged early in October. The species appears to be a woodland form, since Dr Smith states that he has never received it in miscellaneous lots collected near and in towns and villages.

Culex dupreei Coq.

Pl. 46, 53, fig. 3, 6 respectively

This small mosquito, originally described from Louisiana, ranges in color from grayish brown to nearly black. There is on the dorsum of the thorax a silvery white stripe with diffuse edges, which is continued on the head occupying most of the space between the eyes. This species resembles a small C. serratus,

but the stripe is not so well defined and the marking on the abdomen differs.

Description. The larva of this species, as described by Dr Smith, has the head almost twice as broad as long, the antennae are half as long as the head, almost uniform in thickness two thirds from the base, then taper slightly to the tip where there are four articulated spines and a stout, short segment. The sparse tuft of hair is slightly beyond the middle. The air tube is about four and one half times as long as its width at the base, and tapers rather evenly to the tip. Each pecten is composed of about 12 uniformly tapering spines, the latter with three sharp, well defined teeth near the base. The comb is composed of from 8 to 10 flattened, somewhat diamond-shaped scales arranged in a slightly curved row. Dr Smith states that this larva can be at once recognized by its unusually long anal gills and the apparent absence of a breathing tube.

Life history and habits. The young of this species were met with in a woodland pool and are remarkable because of their remaining near the bottom. They were never observed in confinement to rise voluntarily to the surface for air, and when disturbed they sail rather than wriggle upward and immediately descend as soon as quiet is restored. They are so inconspicuous and transparent that a jar containing them would be set aside as empty unless closely examined, and this in connection with their habit of hiding among the leaves at the bottom of the pools renders them difficult to secure. Pupae were met with by Dr Smith, July 29, and adults appeared July 30 and 31, and also at various times during August. Larvae were also obtained early in September, and one adult was bred the 15th. There seems to be continuous breeding from the latter part of July to the end of September, and it may begin earlier in the season.

Culex triseriatus Say

Pl. 10, 25, 46, 53, fig. 5, 1, 6, 5 respectively

This mosquito has the anterior and mid tarsal claws toothed, the posterior ones simple. It may be separated from C. aurifer by the color of the scales on the side of the mesonotum, which are white, while in C. aurifer they are golden yellow.

Description. The larva according to Dyar has the head well rounded, flattened, brown, darker on the vertex. The antennae are long, brown, slender and with a single haired tuft at the middle. The air tube is about three times as long as broad, tapering outwardly, its pecten teeth considerably elongate. The comb consists of a small patch of about 12 stout, rather elongate spines with finely digitately divided tips. They are arranged in an irregular single row.

Distribution. We have taken this species rather sparingly at Poughkeepsie and Albany, while Johannsen has met with it at Ithaca. It has been listed by Dr Howard, from New Hampshire, Connecticut, New Jersey, Pennsylvania, Maryland and Virginia.

Life history and habits. Dr Smith found the larvae of this species in an iron pail half filled with water. He states that they resemble those of Stegomyia fasciata and adds that they are at once recognizable by the intensely black head and the short, black anal tube. Dr Dyar states that captive females deposit their eggs in patches or singly at the edge just below the surface of the water, where they adhere slightly and remain unhatched till spring. We met with adults at Poughkeepsie and Dr Dyar took them at Center Harbor N. H. between June 20 and July 8, he adds that they become somewhat more common, continuing all summer. He believes the species to be single brooded, though he is unable to account for fresh specimens flying all season, and this may possibly be due to a portion of the eggs hatching after each heavy rain, as in the case of C. sollicitans.

Culex aurifer Coq.

Pl. 11, 25, 33, 46, 52, 55, fig. 1, 2; 2, 3; 2; 5; 2; 5 respectively

This form is closely related to C. triseriatus Say, and may be separated therefrom by the golden yellow scales on the sides of the mesonotum. It has been taken in New Hampshire and New Jersey by Messrs Dyar and Smith and we have captured it at Elizabethtown N. Y. Larvae were met with by Mr Brakeley at Lahaway N. J. late in April and in May 1902, where they occurred at a few points only in larger bodies of water associated

with C. canadensis. They were present in one cranberry bog, which was dry during the summer of 1902 and till so late in the fall that all adult mosquito life had gone into hibernation or disappeared. The larvae were found so early as to lead Dr Smith to conclude that they must have hibernated as eggs.

Description. The larva has been described by Dr Smith as being from ¼ to about ⅜ inch in length, brownish black, tapering a little. The transverse, elliptic head is almost as broad as the thorax and is widest just behind the eyes. The white antennae are tipped with black, almost half as long as the head, thickest near the base and tapering slightly to about the middle, then curving inwardly to a blunt point. The tuft of 6 to 10 hairs is just beyond the middle. The transverse thorax is angulated, each segment marked by a tuft of long hairs arising from a tubercle. The comb consists of patches of from 25 to 30 spatulate spine-tipped scales bearing fine setae. The air tube is about three and one half times as long as wide with double posterior pecten, each consisting of from 14 to 20 small slender spines with two to five serrations near the base.

Culex melanurus Coq.

Pl. 46, 48, fig. 1, 6 respectively

This species may be separated from those without abdominal cross bands and prominent stripes on the thorax by the claws being simple.

The larva is stated by Dr Dyar to be very characteristic on account of its dark infuscated tube and plates, and its peculiar comb which resembles a grating, the spines appearing like long bars in a single row.

Distribution. This species has been taken at Center Harbor N. H. and may be expected to occur in New York State.

Life history and habits. Dr Dyar states that the larva is slow in development and very deliberate in all its motions, remaining long at the bottom of the water. It inhabits permanent spring or deep rock pools. The thin black shelled eggs are laid singly on the surface of the water, and breeding is probably continuous, the adult hibernating.

STEGOMYIA

The legs are uniformly clothed with flat scales in this genus, while those of the head and scutellar space are broad and flat. The third longitudinal wing vein is not usually continued into the basal cell as in Culex.

Stegomyia signifer Coq.

This species is very similar to Culex fasciatus Fabr., but may be distinguished from it, according to Coquillett, by the simple tarsal claws, that is, without teeth, and by the tarsal joints being banded at both ends. This is the only species of the genus liable to occur in the State. It has been taken in New Jersey.

Description. The larva is abnormal for this genus, according to Dr Dyar. He states that the peculiar dorsal platings at the end of the body occur also in Corethrella brakeleyi, but not in any other culicid that he has seen. The short antennae and the elongate head suggest Uranotaenia and Anopheles.

Larva. The following characteristics are from Dr Dyar's description:

Head, rounded, elliptic, slightly flattened, black; antennae very short, small tuft before the middle; eyes, black, transverse; seventh abdominal segment with a round, dorsal plate, incised anteriorly. An angulated transverse plate on the eighth segment anteriorly, reaching below the middle of the sides, with the comb at its posterior border but not united with it. The comb consists of long scales in a transverse row and a shorter second row, finely divided on the side next to the body. Air tube is about three times as long as wide, slender, rather small, without pecten but with a hair tuft beyond the middle; a small, linear, transverse, lateral plate on the last segment anteriorly; segment trigonate, ringed by its plate; tuft and brush normal, the latter confined to the barred area; no anal processes visible.

This species was described by Coquillett from the District of Columbia and British North America, and it has also been taken in New Jersey. Dr Smith states that the larva occurs in somewhat foul water, and that it may be recognized by its robust build

and rather sickly white thorax, contrasting with the darker abdominal segments. The antennae differ from those of either Culex or Stegomyia, and the anal siphon has no rows of spines or teeth.

Taeniorhynchus perturbans Walk.

Pl. 11, 26, fig. 3, 3 respectively

This species may be identified by the large elongate, oval, lanceolate, lateral scales of the wing veins. This mosquito is the only one of the genus occurring in the State, and it has previously been referred largely to the genus Culex. Dr Howard has listed this species from a number of localities in the United States and from Porto Rico and Cuba. It is probably widely distributed south of Canada. Its peculiar scales are illustrated on plate 26, figure 3.

AEDOMYINAE

This subfamily contains those mosquitos having very short palpi in both sexes. There are two genera, both of which have been found in New York State. The first, Aedes, is nonmetallic, while the second, Uranotaenia, has metalliclike stripes of flat scales on the thorax.

Key to genera

a Thorax without metallic stripes of flat scales; fork cells normal...Aedes
aa Thorax with metallic stripes of flat scales; fork cells very small ....Uranotaenia

Aedes fuscus Osten Sacken

Pl. 11, 26, 27, 39, 43, 52, fig. 4, 5; 4; 3; 3; 3 respectively

This mosquito may be recognized by its basal abdominal cross bands of cream-colored scales. The larva was met with in early spring at Nassau and Karner where it was associated with Culex cinereoborealis, C. canadensis, C. cantans and C. impiger. We have also taken it at Poughkeepsie. Dr Dyar reports taking it in company with C. canadensis and C. sylvestris, and adds, that like them, it possesses a short breathing tube.

The larva of this species so nearly resembles that of C. sylvestris and C. impiger that it is difficult to separate them. It may be distinguished from that of A. smithii

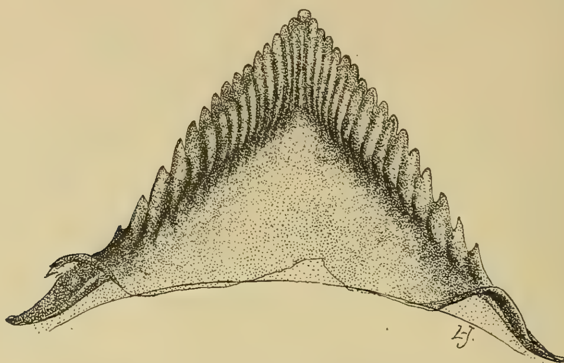


Fig. 77 Labial plate of Aedes fuscus

according to Johannsen by the four long, narrowly tapering blood gills instead of two.

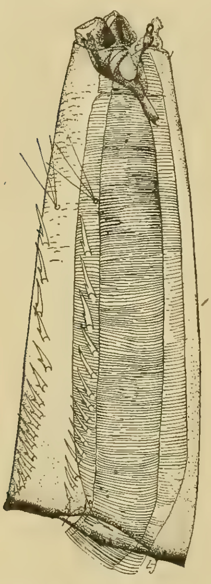


Fig. 78 Air tube of A. fuscus

Larva. Length about $\frac{3}{16}$ inch. Head brown; antennae fuscous at the tip, light brown at the base and with a scanty tuft arising from before the middle; apically there are four rather long bristles and a small, conical process. Labial plate elongated, triangular and with 25 rather fine teeth, those near the apex being smaller than the others. Hairs of the thorax compound, weakly barbuled, those of the abdomen simple. Comb composed of a practically single row of 12 narrow scales, each with a somewhat elliptic, finely setose base and a stout apical spine. Air tube slender, about three times as long as broad, with double posterior pecten, each consisting of about 13 closely set spines, with three flattened isolated ones beyond. Each spine bears a tooth near its base. Anal plate covers the dorsum only of the last segment.

Aedes smithii Coq.

This black species may be separated from the preceding form, by the absence of the cross bands of yellowish scales at the bases of the abdominal segments.

Description. Dr Dyar states that the larva has a rounded, pentagonal, flattened head, and small, slender antennae, possessing an imperceptible tuft. The comb consists of a single row of 15 to 20 scales, and the air tube is shorter than the two abdominal segments, moderate, narrowed at the tip, and with two rows of hairs on the upper and two on the lower aspect. The larva has been minutely described by Johannsen.

Distribution. This species was described from New Jersey, where it occurs in pitcher plants growing in cold bogs, and as this plant flourishes in some portions of New York State, the chances are very good that this species occurs within our limits. Mr Coquillett has also received it from Florida, where it breeds in an orchid.

Life history and habits. This insect is remarkable in that the larvae have been found only in pitcher plants. They pass the winter in such situations, notwithstanding repeated freezing and thawing, pupate late in May and adults appear a week or 10 days later. The eggs are laid in leaves singly or in small groups fastened to the sides or floating on the surface. The summer broods mature in about a week, and there are probably three, if not four generations, but there is so much overlapping that breeding is practically continuous. Late in the season the adults select the new leaves for oviposition, even if they are dry. This species, while apparently limited to pitcher plants, does not breed in all, since examinations in some localities in New Jersey, and a few in New York, failed to discover specimens.

URANOTAENIA Arrib.

This genus presents in many respects the same characteristics as Culex and Aedes. It differs from Culex in having short palpi in both sexes, and from Aedes in possessing violet blue scales on the thorax.

Uranotaenia sapphirina Osten Sacken

Pl. 12, 27, 46, 48, fig. 1; 2, 3; 2; 7 respectively

The single species belonging to this genus is among the smallest of our mosquitos, and may be easily recognized by the line of violet blue scales on the thorax. The larvae were taken in small numbers at East Greenbush in early August.

Description. *Female.* Proboscis nearly as long as the body, dark brown with fine, yellowish hairs. Antennae slender, slightly shorter than the proboscis; segments with sparse, basal whorls of stout, brown hairs and thinly clothed with shorter, yellowish brown ones; basal segment globular, yellowish. Eyes black, coarsely granulate, strongly emarginate; occiput with a conspicuous median patch of bright violet scales extending laterally along the posterior margin of the eyes. Prothorax yellowish or yellowish brown with a bright median line of violet scales becoming obsolete posteriorly; a submedian line of long, coarse, brown hairs and in some specimens a sublateral and lateral stripe of similar hairs; other portions sparsely clothed with shorter, brown hairs; a small patch of violet scales on the anterior lateral margin just behind the head, a few of the same color or a short lateral line at the base of the wings, and a rather conspicuous patch of similar scales on the pleura a little below the wings. Scutellum with a patch of violet scales and bearing a few long, coarse, black bristles; postscutellum yellowish. Halteres, basal portion yellowish white, apical portion fuscous. Abdomen brownish, mottled with yellowish; first and fifth abdominal segments with more or less defined posterior patches of violet scales. Ventral surface of abdomen brownish, sparsely clothed with yellowish brown scales. Legs mostly dark brown, with apexes of femora and tibiae ringed with white. Wings, veins black, membrane hyaline with bright metallic reflections, large, flat scales on second longitudinal vein; basal portion of fifth longitudinal vein thickly clothed with a double row of bright violet scales similar to those on the body.

Fig. 79 Labial plate of Uranotaenia sapphirina

Male. Proboscis long, brownish, flecked with yellowish brown scales. Antennae with dark brown plumes, jet black, segments with basal, yellowish rings. Occiput crowned with several patches of purplish scales. Prothorax brownish, with a median and

lateral stripe of bright violet scales, a submedian and sublateral line of dark, coarse bristles. Scutellum nearly black, ornamented with violet scales and tipped with a few very long, black bristles. Abdomen dark brown, flecked with yellow particularly on the fifth, sixth and seventh abdominal segments, the posterior lateral angles of which are narrowly yellowish, the third and fifth with a median, posterior, subtriangular whitish patch, that on the latter segment being much larger than the other; genitalia yellowish. Pleura with several irregular patches of yellowish white and a line of violet scales. Legs mostly dark brown, yellowish beneath and with narrow, white bands at the apexes of femora and tibiae; ungues simple. Wings subhyaline; veins brownish or black, anterior veins thickly clothed with nearly black dilated scales; a double row of violet scales on basal half of fifth longitudinal vein; fringe silvery gray; basal portion of halteres whitish, apical portion capitate, fuscous; first submarginal cell very short, with petiole bearing about six very large spatulate scales, second fork cell a little over one half the length of the petiole; posterior cross vein a little less than its length from the mid cross vein.

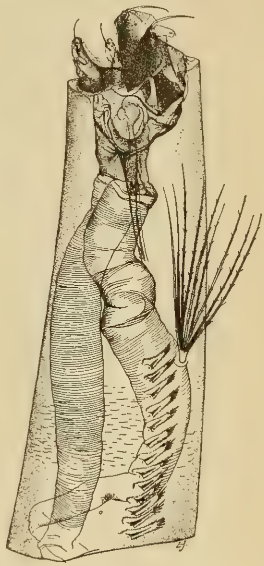


Fig. 80 Air tube of U. sapphirina

Larva. Head jet black in early stages, distinctly longer than wide and presenting an appearance very similar to that of Anopheles. Antennae jet black, short, swollen at the base, the inconspicuous tuft a little before the middle. Apex bearing two longer, slender processes, a medium and a large, shorter one. Labial plate narrowly triangular with about 10 conspicuous teeth, and appears to be double like that of Anopheles. Dorsum of head with two subdorsal pairs of barbed spinelike processes. Compound groups of plumose hairs also occur on the head and on the prothorax, and are continued on the abdominal segments except that in the case of the latter, the hairs are not plumose. Thorax and abdomen greenish yellow, the thoracic segments being distinctly broader, margined laterally by fuscous, and the entire

body with a broad, fuscous stripe along the median line. Comb consisting of about seven simple, conical teeth attached to the posterior border of a lateral plate. Air tube about three times as

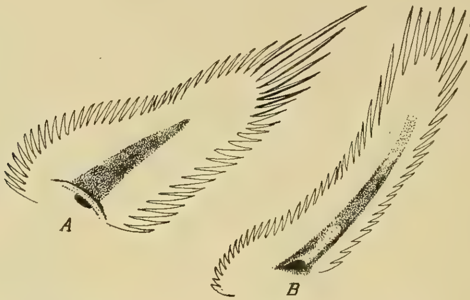


Fig. 81 Pecten teeth of U. sapphirina; A apical, B basal

long as wide, subcylindric, somewhat curved, and with a pair of apical valves, each about as long as one half the width of the tube. Pecten extend nearly to the basal half of the air tube, where there is a conspicuous pair of compound hairs, composed of about 13 teeth, which are unique on account of the nearly conical portion bearing a lateral and apical, semitransparent, serrate fringe, which extends beyond the dark tip a distance almost equal to the basal portion, the apical pecten teeth with a longer median spine, the basal ones with apical spines subequal. Ventral tuft composed of about six stout, compound hairs, the dorsal extremity of last segment bearing a pair of compound hairs; posterior margin of the same ornamented with peculiar groups of small spines.

Fig. 82 Terminal segment of U. sapphirina

Distribution. This species was described from specimens taken on Long Island and has been met with in New Jersey by Dr Smith, and according to Theobald it has been obtained by Dr Howard at Ithaca.

Life history and habits. This species is neither common nor troublesome, according to Dr Dyar. The larvae were found in a large pool near a cold stream and in a warm marshy pool at Bellport L. I., occurring sparingly here and there. Both places were permanent bodies of water and contained aquatic plants. The eggs are deposited as a boat-shaped mass, which floats on the water, much as Culex pungens, but the mass is smaller, contains fewer eggs and is less regularly elliptic. The normal feeding position of the young larva resembles Culex, but the body is more nearly parallel to the surface. The larvae are fond of resting under the leaves of Lemna, where they remain with the air tube penetrating the surface film. There appear to be four larval stages, and the species seems to breed throughout the summer, preferring warm, stagnant pools of some size containing Spirogyra.

CORETHRINAE

This subfamily includes some very interesting forms which have been largely neglected, probably on account of their relatively slight economic importance and also because of their retiring habits. So far as known, all are predaceous and therefore more or less beneficial. Among them we find a most efficient destroyer of mosquito larvae, Eucorethra underwoodi, which is unfortunately a form of small value because of its extremely local habits, since it appears to be confined almost entirely to very cold spring pools in deep woods. The peculiar, nearly transparent, phantomlike larvae of Sayomia belong here, and the still more interesting Corethra larvae, which appear to be intermediate in structure between those of Sayomia and Culex, are also members of this subfamily. Eucorethra has been known only since 1900, and Corethrella, represented by a species with very interesting habits, is a more recent discovery.

Key to genera

a First tarsal segment longer than the following segment
  b Species less than $\frac{3}{16}$ in. in length; tarsal claws simple
    c Antennae verticillate with hairs i. e. in whorls.... Sayomyia
    cc Antennae wholly covered with hairs, legs densely haired .... Corethrella
  bb Large species $\frac{3}{8}$ in. or more in length; tarsal claws bifid. Eucorethra
aa First tarsal segment shorter than the following segment.... Corethra

CORETHRELLA Coq.

This genus was erected for a peculiar species presenting characters similar to Sayomyia and Corethra, but differing from both in having the antennae fully covered with hairs and the apical joint shorter than the intermediate ones. The larva also presents differences from the ordinary culicid type.

Corethrella brakeleyi Coq.

This species has been described by Mr Coquillett, as follows:

Dark brown, the antennae, halteres, knees and tarsi yellow; plumosity of male antennae yellow, mesonotum opaque, gray pruinose except three narrow vittae and a few spots near the humeri, hairs of thorax brownish, those of the abdomen yellow, tibiae and tarsi bearing many long hairs; first joint of front tarsi slightly shorter than the tibia; wings whitish hyaline, marked with a brown cross band near one third and two thirds its length, the first one oblique, the second band produced triangularly near middle of its inner side, costal margin on each side of this band strongly tinged with golden yellow, fringe white, marked with a brown spot at posterior end of each cross band and on either side of the extreme wing tip; length, 1.5 mm.

The larva resembles that of Corethra much more more closely than that of Sayomyia. This curious form is about ⅛ inch in length, light reddish in color and very hairy in appearance. The head is broad and the body tapers gradually to the short, obtuse anal siphon, giving it a somewhat triangular appearance. It differs from the former, according to Johannsen, in having the antennae attached near the middle line of the head, at the extreme anterior end, and hinged so that they move in a horizontal plane, normally folding back against the side of the head. Dr Smith states that there is no mouth brush, that the eyes are rounded, and the abdominal hairs unequal.

The pupa is brown in color, and floats upwardly to the surface with the long, slender air tubes slightly projecting. The larva and pupa have been minutely described by Johannsen.

Habits and life history. This interesting culicid was discovered by Mr J. Turner Brakeley at Lahaway N. J. in little pools near the head of a swamp spring. The first captures were taken June

1, and July 27, and a number of others were obtained in grassy shelters around the edge of a lily pond full of fish. Dr Smith states that the little creatures remain almost motionless for hours, some at the surface, others below at various points, the former in a position intermediate between that assumed by Anopheles and that characteristic of Culex. Larvae transformed the last of July, and the pupae were just as odd as the larvae, reminding one of Lycaenid chrysalids with breathing tubes. They remained at the surface, seemed to have little motive power and were easily submerged and drowned. Adults appeared Aug. 2, giving a period of four and one half days for the pupa. Larvae were also met with Aug. 13, Sep. 17, Oct. 14 and 20. In each case half to full grown specimens were found.

CORETHRA

This genus is remarkable because the first tarsal segment is shorter than the second, and in the four species we have studied there is only a pseudo-articulation between the two. It appears to be a case where reduction is in progress. The larva is not less remarkable than the adult and presents an intergrade between the ordinary culicid form and that of Sayomyia. It may be easily recognized by the possession of a culicid air tube in connection with the enormously swollen thorax containing a pair of large air vessels and a smaller pair in the somewhat enlarged seventh abdominal segment. The larvae remain almost motionless and horizontal at variable depths in the water and very rarely come to the surface. This is probably due to the large supply of oxygen in the air vessels mentioned above. We have adopted Coquillett's reference of this form, hitherto known as Mochlonyx, to Corethra, and the species commonly known under the latter name we have transferred to the genus proposed by the same author, namely, Sayomyia.

Corethra karnerensis n. sp.

Two larvae belonging to this species were taken from a stagnant pool at Karner N. Y., May 14, 1902, and one male obtained. This species was originally referred to the European C. v e l u t i n a .

Giles and Theobald are both of the opinion that there is but one European species, and as our species in both adult and larval form

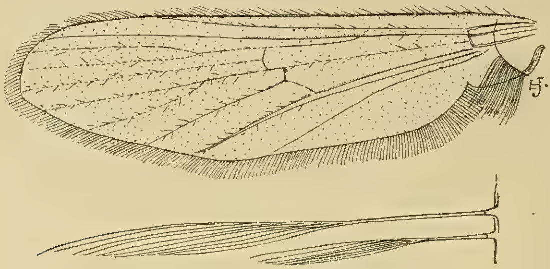


Fig. 83 Wing of Corethra karnerensis

presents some difference from specimens sent us by Dr Meinert of Copenhagen, Denmark under the name of Mochlonyx culiciformis, we have decided to characterize it as new.

Fig. 84 Last tarsal segment and one claw of C. karnerensis

The adults agree very closely, but we find that in the male of C. culiciformis the posterior cross vein is less than its own length from the mid cross vein, while in our species this distance is greater than its length. The tip of the posterior marginal cell is nearer the base of the wing in C. culiciformis, whereas in C. karnerensis the tip of the anterior marginal cell is nearer the base of the wing. The larvae present more striking differences than the adults. The peculiarly dentate scales bordering the labial plate in C. culiciformis have about eight apical teeth, whereas in C. karnerensis there are but three or four. The mandibles of C. culiciformis have from seven to eight teeth, and in C. karnerensis there are eight to nine. Other differences would probably be detected with abundant material of this American species, which is unfortunately lacking at the present time.

Description. *Male.* Head, light brown, transverse; eyes, large laterally, emarginate; antennae, plumose, verticillate, 14 joints, the basal reddish, nearly globular; palpi five jointed, first and

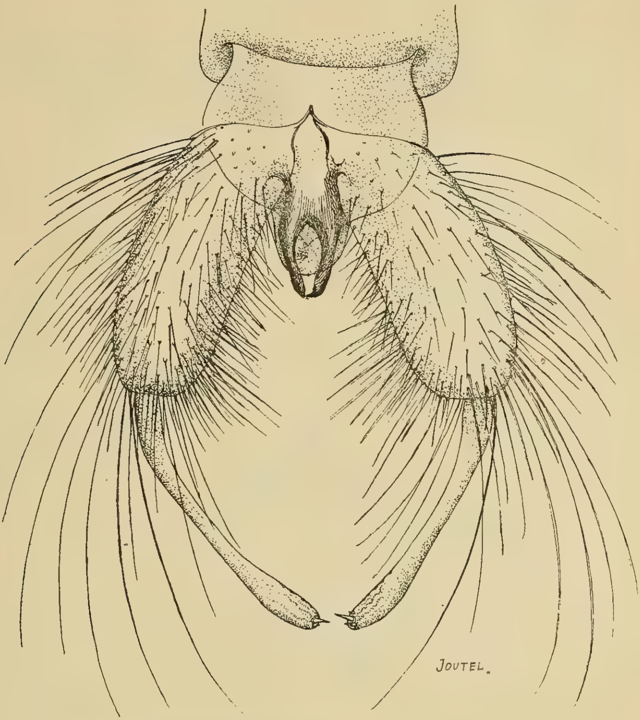


Fig. 85 Dorsal aspect of genitalia of C. kárnerensis

second short, each bearing several long, stout setae, the third and fourth nearly equal in length, and the fifth slender and nearly twice the length of the fourth, the distal three sparsely clothed

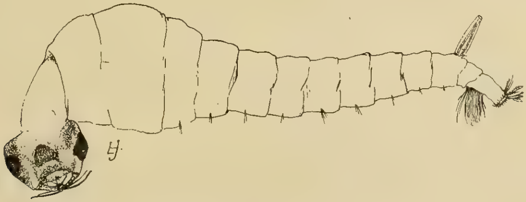


Fig. 86 Side view of larva of C. karnerensis

with short setae. Labium short, rounded at apex, bearing on what appears to be a tactile surface, a few scattering setae. Ventral aspect rather thickly clothed with stout setae.

Thorax brown, evenly swollen, the arched scutellum rather prominent; abdomen yellowish, with posterior lateral brownish or black markings on each segment. Basal segment of clasp stout, swollen; apical nearly equal in length, more slender and bearing

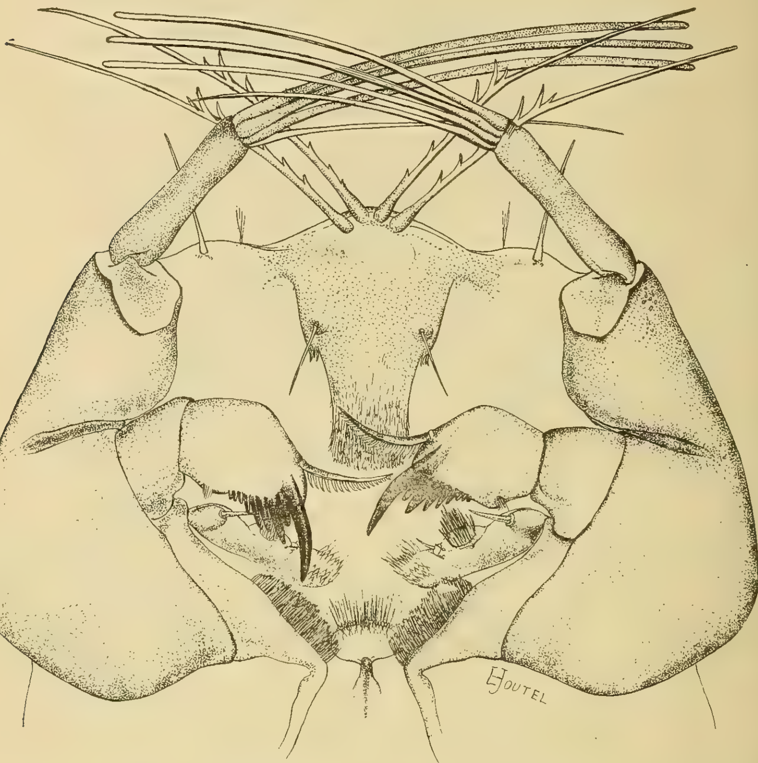


Fig. 87 Ventral aspect of head of C. karnerensis

at its apex a short, stout spine. Harpes short, irregularly curved and tipped with a stout, short point.

Legs, pale yellowish, sparsely clothed with rather coarse hairs. Femora and tibia nearly equal in length, first tarsal segment about one fifth the length of the second, the articulation between the two being rudimentary; third tarsal segment about one half the length of the second, the fourth one third shorter than the third, and the fifth a little shorter than the fourth, with a basal, knoblike posterior enlargement. Claws equal, two toothed, one at the base and the other about midway of the curve.

Wings, slender, sparsely fringed with hairs, posterior cross vein a little more than its length from the mid cross vein. Both submarginal cells longer than their petioles.

Larva of the normal Corethra type with the prothoracic and seventh abdominal segments enlarged and containing air reservoirs.

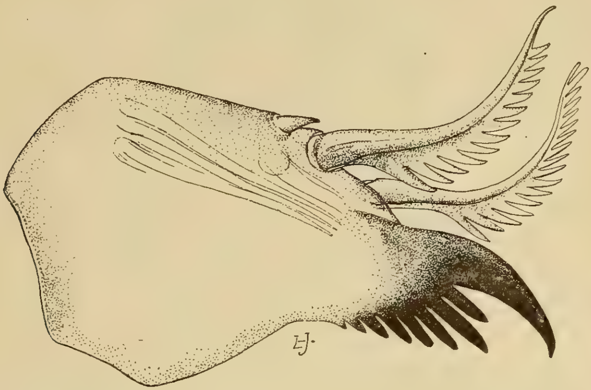


Fig. 88 Dorsal aspect of larval mandible of C. karnerensis much enlarged

Head, light brown, flattened; eyes dark brown, nearly black; the median four frontal setae barbed along the basal half, the

Fig. 89 Variations in oral hairs in C. karnerensis: a from labrum, b from labium and c from the maxillary palpus

lateral frontal setae, slender, simple, curved. Tip of labrum thickly fringed with serrate scales and with a peculiar cluster arising from a pocketlike depression on either side; there is a pair of

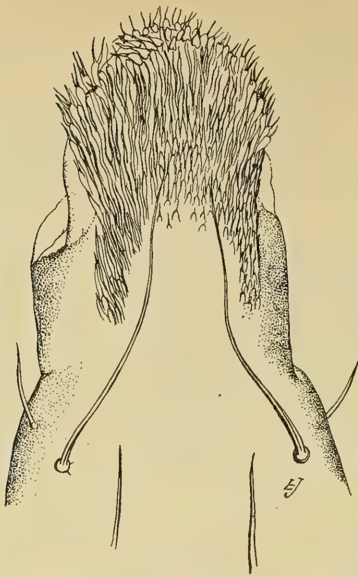


Fig. 90 Labrum of C. karnerensis

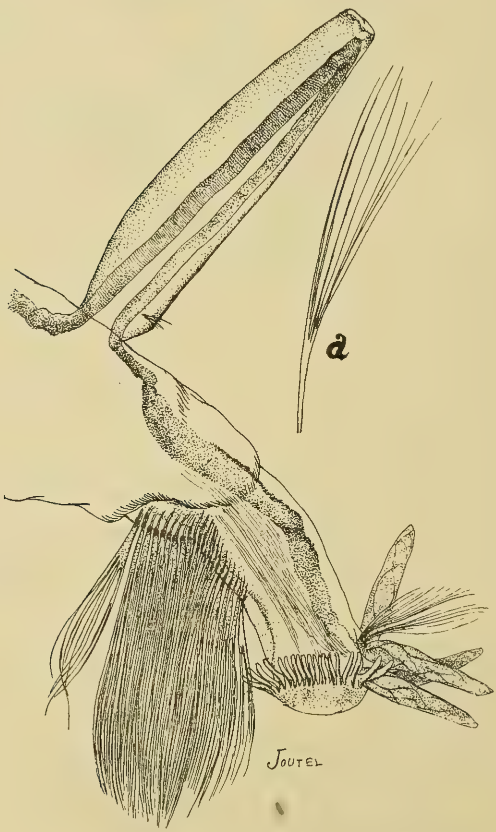


Fig. 91 Side view of siphon and anal segment of C. karnerensis

long, slender, somewhat curved spines on each side near the middle. Basal segment of antennae short, cylindric, and tipped with three nearly equal simple processes and a fourth slightly over half the length of the others. Mandibles nine toothed, and bearing two barbed processes with a rudimentary spine at the base of the second. Siphon somewhat fusiform, its length about four times its greatest diameter and the anterior respiratory trachea joining the posterior one before reaching the tip of the siphon. Ventral tuft of the anal segment thick, extending along the entire barred area and consisting of numerous branched hairs; dorsal tuft small and composed of only a few hairs. Anal processes fleshy, four, tapering to an obscure point; the tip of the segment bordered by numerous short, recurved, fleshy processes.

Corethra lintneri n. sp.

Pl. 27, fig. 4

Larvae of this species were taken June 9, 1904, in a cold mountain pool near Elizabethtown N. Y., where they were associated with larvae of Culex lazarensis, C. abserratus, C. cinereoborealis and Eucorethra underwoodi. Several adults emerged June 16 and 17.

Description. *Female.* Antennae slender, sparsely clothed with yellowish hairs, slightly fuscous apically, and each segment with

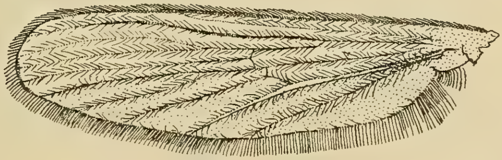


Fig. 92 Wing of female of Corethra lintneri

a narrow, basal, fuscous ring. Palpi fuscous, basal segment short, subglobose, second to fourth subequal, rather densely clothed with coarse hairs, the terminal one remarkably distorted. Labial palpi very short, subglobose. Occiput and thorax densely clothed with long, golden yellow scales, the latter with a pair of submedian, naked lines on the anterior two thirds. Pleura semitransparent, yellowish. Abdomen yellowish, irregularly marked with fuscous, specially along the posterior margin of the segments, sparsely clothed with long, yellowish hairs. Dorsal plate of terminal segment rounded, with a marked, median indentation. Ventral surface yellowish, sparsely clothed with fine, yellowish hairs, with the posterior portion of the segments naked and

lighter. Legs, yellowish, apexes of tarsal segments somewhat fuscous, sparsely clothed with fine, fuscous hairs; ungues unidentate, the basal tooth being so strongly serrate that it is almost pectinate. Halteres knobbed, uniformly yellowish. Wings straw yellow, rather sparsely clothed with slightly fuscous hairs. Petiole of first submarginal cell about one third the length of the extremely long, narrow cell; that of the second posterior cell about one half its length. Posterior cross vein a little over its own length from the mid cross vein.

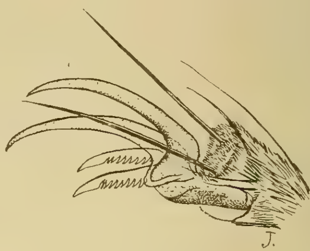


Fig. 93 Female claws of C. lintneri

Male. Antennae with long, grayish plumes annulated with white, basal segment hemispheric, deeply excavated distally. Eyes, green in life, palps grayish fuscous clothed with rather coarse hairs. Thorax sparsely clothed with long, golden yellow scales. Pleura slaty gray, under surface of abdomen semitransparent, whitish. Abdomen yellowish white with lateral, irregularly triangular blotches near the middle of each segment; laterally, sparsely clothed with long, yellowish hairs. Legs, nearly uniformly straw yellow. Halteres knobbed, pale yellowish at tip, almost semitransparent at base. Coloration of legs about as in female, ungues bidentate, the basal tooth on the fore leg slightly pectinate at base, that on middle leg slightly serrate and on the hind leg plainly so. Dorsal plate uniformly rounded. Basal segment of clasp much enlarged, uniformly rounded exteriorly and sparsely clothed with long, rather stout hairs, specially internally on the distal third. Distal segment very long, slender, rather irregular and tipped with a small, rather stout, slightly curved spine. Harpes irregularly curved and tipped with a stout, short spine.

Fig. 94 Labrum of C. lintneri

Larva. About 8 mm long with head brownish, fuscous. Eyes and portions of antennae black; body brownish, and with air

vessels in the enlarged prothoracic and seventh abdominal segments. The larva is not readily seen in the water though not transparent. Antennae, basal segments stout, uniform, and bear-

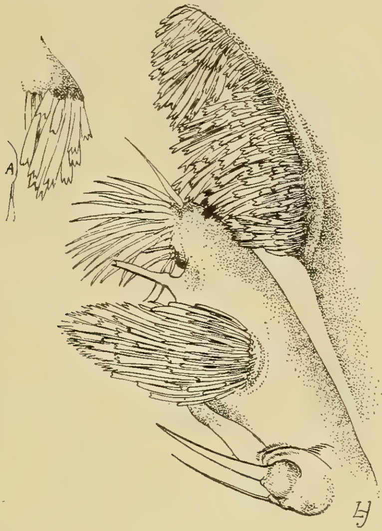


Fig. 95 Maxillae and labium of C. lintneri

ing three long and one shorter decurved processes; median four frontal setae with few small spines near distal third. Labrum with the sublateral, long, wavy, serrate, tipped scales arranged in rows on its distal fourth, the scales at its extremity being long, irregular, slender, expanded apically usually into three large spinelike processes. Mandibles fuscous with eight powerful teeth, bearing at the base two barbed hairs, one long and a short rudimentary spine, basal cluster composed of about four large, simple processes. Labial scales and those of other parts much like those of C. karnerensis. Siphon slightly fusiform, about three times as long as its greatest diameter. Ventral tuft on the anal segment thick, extending along the entire barred area and consisting of numerous branched hairs. Dorsal tuft small and composed of several compound hairs. Anal processes rather stout, somewhat short, tapering to an obscure point. Obscure

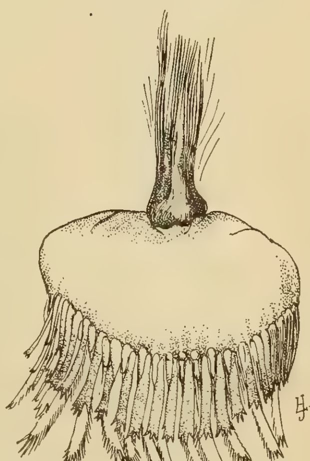


Fig. 96 Labium of C. lintneri

comblike structures appear to form a dark colored lateral patch near the posterior third of the segment, the bases of the spines being fused together.

Corethra cinctipes Coq.

Pl. 28, fig. 1

This species was described last year by Mr Coquillett, who had received specimens several years before from Franconia N. H., and also from Mt Vernon Va. It was bred by us from larvae taken in a woodland pool at Karner May 10, 1904, adults appearing May 15. This species according to Mr Coquillett may be readily recognized by its banded legs and mottled wings.

Description. The original description of the adult is as follows:

Blackish brown, the apices of the antennal joints except the last joint, the halteres, bases of the segments of abdomen in the male, base and under side of femora, a broad band near four fifths of their length, their extreme apices, bases of tibiae and a band near one fourth of their length, also bases of the first three or four joints of the tarsi, yellow; hairs of male antennae brown, their bases yellow, those at tips of antennae almost wholly yellow; thorax grayish pruinose, marked with four black vittae; wings grayish hyaline, hairs of veins black and with yellow ones as follows: on the bases and apexes of the veins, on the first vein where the second issues from it, on the second vein where the third issues from it and at the point where it forks, on the fourth vein at the insertion of the cross vein and also where this vein forks, and on the fifth vein where it forks; first submarginal cell nearly twice as long as its petiole, cross vein at apex of second basal cell less than its length before the one above it; tarsal claws of male each bearing two long, slender teeth on the under side, one near the base and the other near the middle, those of the female with a single tooth near the base of each; length, 3 to 4.5 mm.

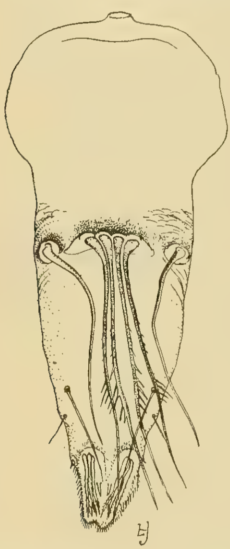


Fig. 97 Labrum of larva of C. cinctipes

Larva. About ¼ inch long. Head light brown, eyes dark brown. Tip of labrum thickly fringed with serrate scales and

with a peculiar cluster of much longer spined ones arising from a pocketlike depression on either side; there is a pair of long, slender, somewhat curved spines on each side near the middle. Median four frontal setae, each bearing a number of small spines and two longer, stouter processes near the distal third; lateral pair long, simple, slender, much curved. Basal segment of antenna short, bearing four long, stout, and one slender, apical processes. Mandibles stout, black, with about seven teeth, and four well developed barbed processes near the base. Air tube regularly tapering, length about three and one half times its greatest diameter. At the base of the air tube there is an irregular group of many branched, compound hairs comparable in position and general arrangement to the comb scales on the eighth segment of Culex larva. These are detected only on cast skins. Terminal segment slender, not much larger than the air tube. Ventral tuft of hairs thick, extending along the entire barred area; dorsal tuft small and composed of only a few hairs. Fleshy anal processes four, tapering to a rounded point.

EUCORETHRA Undw.

This genus was erected for a large mosquito closely related to Corethra and Sayomyia.

Eucorethra underwoodi Undw.

Pl. 12, 28, 39, 47, fig. 2, 3; 2; 4; 3 respectively

This interesting and till recently unknown larva was met with in large numbers in a cold mountain pool near Elizabethtown N. Y. June 9.

This insect has been carefully described by Mr Johannsen, who was the first to carefully study the species.

Female. Antennae sparsely haired, black; basal segment globular, yellowish; labrum densely haired, much prolonged, black, tipped with brownish yellow; palpi dark brown, rather densely clothed with blackish hairs. Labium, basal portion dark brown, apical portion golden yellow. Anterior and lateral portions of thorax a rich dark brown, sparsely clothed with a median line of bright, golden yellow scales and with a similar lateral patch extending over the humeri and to the base of the wings; anterior portion of this latter with the short, grayish pile showing only in certain lights, because of the rich brown beneath; posterior portion grayish only. Posterior dorsal portion of thorax, scutellum and postscutellum grayish, the scutellum crowned with a row of long, golden brown hairs; sides of the thorax variable, grayish

and brown. Abdomen grayish, with the lateral and posterior margins of the segments dark brown, clothed with fine, golden hairs. Ventral surface similarly marked, except that the anterior portion of each segment, as well as its basal margin, is more or less brownish. Coxae gray, clothed with golden yellow and brownish hairs. Femora dark golden, with a nearly black band close to the apex, the articulation at the extreme tip of both femora and tibiae bright golden yellow. Tibiae yellowish, tip golden yellow. Tarsi dark, yellowish; ungues golden. All the legs clothed with rather short, thick, dark

Fig. 98 Antennae and mouth parts of Eucorethra underwoodi

brown hairs. Base of halteres golden yellow; apex enlarged, capitate and fuscous. Wings spotted with dark brown or fuscous; veins rather thickly clothed with narrow, nearly black scales and with three distinct spots along the radius, a large discal spot, a smaller one at the base of the first submarginal cell and a still smaller one at the base of the second.

Petiole of first submarginal cell about one half its length; that of the second twice its length. Posterior cross vein almost interstitial with the mid cross vein.

Described from a freshly bred specimen.

Male. This sex has not been described hitherto.

Antennae densely plumose, brown; basal segment globose, variably brown, others with basal, semitransparent annulations. Palpi dark at base; first segment short, second medium, third and fourth segments subequal, lighter. Prothorax as in female.

Abdomen brownish black, with conspicuous, yellow patches on the six anterior segments, being separated by a darker, median line and the denser color of the anterior and posterior portions of each segment; the dorsum of the posterior segments black and all sparsely clothed with golden yellow hairs. Markings of legs as in female; claws equal, bidentate, much like those of female Corethra. Venation and marking of wings shown in plate 12, figure 2, 3. Scales much thinner as in other male Culicids.

Larva. The larva is about 5/8 inch in length and resembles that of Sayomyia and Corethra in the form of the antennae, which are elongate and tipped with three stout, equal processes. The highly developed mandibles have three conspicuous teeth, the largest with two basal teeth, and this sclerite also has several minor processes. The head is nearly square, as seen from above and the thorax has prominent lateral angles, these and the anterior four abdominal segments being provided with conspicuous lateral tufts of compound hairs, which are specially well developed on the thorax. The dorsum of the eighth abdominal segment bears a short, five-lobed air tube, having a somewhat star-shaped appearance from above. A pair of tracheae end at the base of the anterior lobe. The terminal segment bears a conspicuous, very thick ventral fan and the posterior extremity has a thick, dorsal tuft of compound hairs. The four anal gills slender, long, tapering to a rounded tip.

The pupa resembles that of Culex and Anopheles.

Life history. This species was first brought to our attention in June 1900, when examples from a cold spring at Saranac Inn were submitted for identification to Dr Needham. Larvae of what is undoubtedly this species were found by Professor Underwood in January 1903, in a spring of water in Penobscot county, Me. This species passes the winter as larvae, since they are met with in very early spring and have even been taken from under ice. The larvae, like those of Anopheles, float at the surface of the water in a nearly horizontal position, and when disturbed dive quickly, taking refuge on the bottom where they may remain several minutes, ascending later with a vigorous wriggling motion. They are voracious feeders, not only devouring large numbers of Culex larvae, but in the absence of more suitable

food attacking each other, and were it not for its local habits, this species might prove a valuable aid in reducing the numbers of those species of mosquitos annoying to man and the lower animals. This insect is evidently widely distributed, as larvae were met with in 1903 in the Kootenay district, British Columbia, by Dr Dyar, where they occurred in cold pools at Glacier and also in rain water barrels.

SAYOMYIA

Phantom larvae

The small gnats belonging to this genus have a close resemblance to the biting, annoying culicids. We are happy to state that they are harmless, their short mouth parts being specially adapted to feeding on vegetation. The larvae are the most interesting of all and may at once be separated from those belonging to the genus Culex by the absence of the characteristic air tube. The fore part of the head is much prolonged, and the stout, basal, antennal segment is terminated by four usually equal, pendant filaments and another about half the normal length. These larvae are also remarkable for the eversible pharyngeal tube terminating in a circular papillate organ, evidently for the absorption of food. The almost perfect transparency of the larvae renders them exceedingly difficult to detect, the black eyes and pigment in the air reservoirs of the thoracic and abdominal segments being about the only color. They remain almost motionless some distance below the surface and then with a sudden jerk change from one place to another with a motion so rapid that ordinarily it escapes the eye. The larvae never come to the surface and are predaceous, being credited with feeding not only on small crustaceans but also small dipterous larvae and even young fish. They are said to occur in all kinds of water, specially that which is clear, and, unlike Culex, may be met with where fish abound. The pupae are nearly straight and remain almost upright some little distance below the surface. They are at first white, gradually changing to yellowish brown or green and the segments may even become margined with black.

Sayomyia punctipennis Say

This species has been taken in Pennsylvania, and very likely occurs in this State. Its description is as follows:

Whitish; wings and feet punctured with fuscous. Hair of the antennae yellowish white, the centers of the whorls being fuscous; the shaft of the antennae has a decidedly annulated appearance; eyes black; thorax with three pale yellowish brown abbreviated, broad lines, the middle one originating before and terminating at the center of the disk, the lateral ones originating rather before the middle; feet with numerous small, brown punctures; wings with many very obvious brown spots. Length 6 mm.

Sayomyia trivittata Loew

Pl. 12, 13, 28, fig. 4; 4; 3 respectively

This species has been met with at Elizabethtown, where larvae and pupae occurred in a cold mountain pool June 9, adults appearing the next day. Dr Dyar records this species from Center Harbor N. H. Osten Sacken's description of the adult follows:

Pale yellowish, with three thoracic stripes, the metanotum, fasciae of the abdomen, with apical rings of the femora, and basal

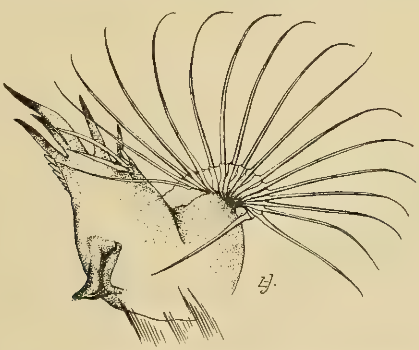


Fig. 99 Mandible and mandibular fan of Sayomyia trivittata

and apical rings of the tibiae, fuscous black; the wings with cinereous spots. Length 4.3 mm. Wing 5 mm.

Pale yellowish, with long, mostly subfuscous pile. Antennae black, annulated, densely verticillate with subfuscous hairs. Dorsum of thorax with three black stripes, the double median one posteriorly, the lateral stripes anteriorly, much shortened. The sides of the scutellum fuscous; metanotum fuscous black; the

abdomen fasciate with fuscous. Legs pale yellow; the tarsi from the tip of the first joint pale fuscous; an apical ring on each of the femora and an apical and a basal ring on each tibia is blackish. The wing variegated with some small cinereous black spots.

Fig. 100 Leaflike appendages of S. trivittata

Fig. 101 Processes much enlarged of terminal segment of S. trivittata

Pupa. Air tube with irregularly hexagonal cells, about four times as long as wide; inner edge nearly straight, outer more or less regularly curved. Apex with a rather distinct, chitinous tip. Ventral surface of abdominal segments thickly clothed with rather long, slender hairs usually extending laterally. Apical three fourths of the inner margin of the hind paddle distinctly serrate, each tooth bearing a short, colorless spine. Terminal appendages consisting of two pairs of conic processes, the outer ones ending in a colorless spine, concave and inclosing the bases of the inner, shorter, more strongly curved ones. At the extreme base of these posterior processes there are a pair of chitinous, irregularly curved, blunt hooks.

Fig. 102 Ventral hook of S. trivittata

Larva. Head, somewhat elongate, subconic. Basal segment of antennae long, deeply notched at base and tipped with four nearly equal, tapering processes and another just about one half their length. Just behind the antennae are 10 long, light brownish filaments, five on each side, the filaments of the third meta-

mere of Meinert. Leaflike appendages long, terminated by an extremely long, slender spine, followed by an irregular series of slender ones along the oblique posterior border, anterior margin gently rounding to a rather broad base. Maxillae irregularly rhomboidal, maxillary palpus tapering gradually, nearly straight. Labrum subquadrate, distinctly wider at the base and with the apex slightly curved and thickly clothed with rather coarse hairs. Mandibles with three fine and several minor teeth, the mandibular fans consisting of about 16 long, spinelike processes. Eyes and air sacks of thoracic and seventh abdominal segments deeply pigmented. Ventral brush of terminal segment composed of about 26 stout hairs. Apical ventral plate fulvous, bearing a stout, curved, chitinous hook pointing anteriorly. Lateral posterior margin of terminal segment bordered with a row of stout, curved, comblike processes, each with a conspicuous tooth at its base. Just behind these and apparently arising from the same chitinous ridge, there are long, curved, corrugated, blunt, ribbed processes which appear to project backward. Extreme dorsum of last segment with four conspicuous plumose bristles. Anal gills long, tapering rather irregularly to acute points.

The pupa remains upright in the water or resting on the bottom, rarely coming to the surface. It is yellowish at first, becoming a dark green with black margined segments. This species has been taken by Dr Dyar, in British Columbia and is recorded by Osten Sacken from Maine, California and Alaska.

Sayomyia albipes Johans.

Pl. 47, fig. 2

Larvae of this species were met with at Bath-on-Hudson June 16, a male emerging the 23d, and we give herewith descriptions of the hitherto unknown male, pupa and larva. The type of this species was taken by Mr Johannsen at Ithaca, in August 1901, and his description of the female follows:

Female. Entire insect pale yellow in ground color; head and antennae wholly pale yellow; dorsum of thorax with three longitudinal stripes, pale buff in color, the lateral ones abbreviated anteriorly, the median one posteriorly, the latter divided longitudinally by a pale yellow line. These stripes all narrowly margined with brown, and on the anterior and outer margins of the lateral stripes are a few tiny black specks. Scutellum with a pale buff posterior margin; pleurae yellow, sparsely sprinkled with small, irregular black specks; abdomen yellowish white beneath,

pale buff colored above, lateral margin sparsely sprinkled with small irregular black specks; legs pale yellowish, unspotted, fourth and fifth tarsal joints slightly darkened; claws simple; legs and abdomen covered with long, loose yellow hair; wings uni-

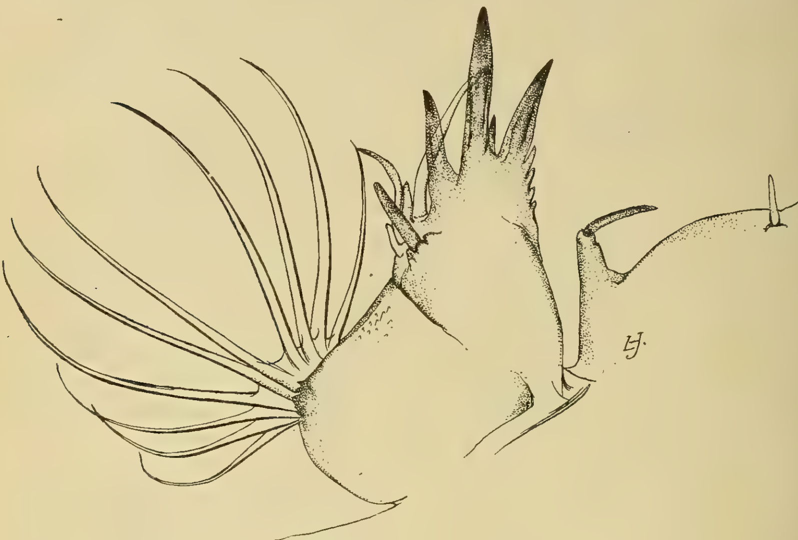


Fig. 103 Mandible and mandibular fan of Sayomyia albipes

formly pale yellowish, the veins, the hair on them and the halteres same color. Length 5½ mm.

Male. Antennae thickly clothed with long, black grayish plumes; basal segment subglobose, yellowish; other segments semitransparent, annulate with yellowish. Palpi short, thickly clothed with dark brown or almost black hairs. Basal segment rather short, subconic, second and third equal, stout; terminal segment slender, nearly twice the length of the third. Eyes, black. Thorax with submedian, straw yellow lines abbreviated posteriorly and margined laterally with dark brown; sublateral stripes of the same color posteriorly, margined with dark brown anteriorly and toward the middle and with a rather broad, lateral, white stripe; sparsely clothed with rather long, fulvous hairs. Abdomen whitish, with an irregular, bluish tint in places and irregular fuscous spots at the anterior lateral margins of the first to sixth segments inclusive; several minute dorsal, black spots on the posterior abdominal segments. Ventral surface unicolorous,

Fig. 104 Leaflike appendages of S. albipes

semitransparent, whitish. Basal segment of clasp straw yellow, nearly cylindric, densely clothed with long, yellowish hairs, apical portion slender, nearly straight, dark brown. Harpes near base of claspers, chitinous, claw-shaped. Legs, pale straw yellow, rather sparsely clothed with pale straw yellow hairs. Anterior tarsi and terminal segment of middle and posterior tarsi distinctly shaded with gray, ungues simple. Wings, pale straw yellow, veins sparsely clothed with similar colored scales; posterior fringe pearly white. Posterior cross vein less than half its length from mid cross vein. Petiole of first submarginal cell about one third the length of cell, that of posterior submarginal cell nearly one half the length of cell.

Described from a recently emerged, well colored individual.

The larva of this species is as transparent and difficult to detect in the water as the species met with at Poughkeepsie, and its transparency is likewise retained in balsam.

Fig. 105 Labrum of S. albipes

Pupa. Air tube with irregularly hexagonal cells, about four times as long as wide, inner margin nearly straight, outer more or less uniformly arcuate; tip light brown, chitinous. Posterior three fourths of the inner edge of the inner paddle distinctly serrate, a few teeth near the tip at almost right angles to the margin. Posterior appendages simple, subconic, with inner margin slightly irregular, serrate near the apical fourth, and at their base an inconspicuous pair of subtriangular lobes.

Fig. 106 Ventral hooks of S. albipes

Larva. Head, somewhat elongate, subconic. Basal segment of antennae long, deeply notched at base and tipped with four nearly equal, tapering processes and one about half as long. Just behind the antennae are 10 long, light brownish filaments, five on each side. These are the filaments of the third metamere of Meinert. Leaflike appendages slender, rounded anteriorly to a narrow base

and terminating acutely with fine serrations on the nearly straight, anterior margin. Labrum quadrate, elongate, obliquely truncate, tipped with an irregular tuft of hairs. Maxillae subtriangular with slightly curved tip. Maxillary palpus slender, tapering, curved. Mandibles with three prominent and two minor teeth; posterior margin slightly serrate. The conspicuous mandibular fans consist of about 10 long, curved spines. Eyes, deeply pigmented. Air sacks of thoracic and seventh abdominal segments with many purplish, pigmented cells; the eversible pharynx with a circular, papillate tip or base and a central, straight and two lateral curved papillae. Ventral tuft of terminal segment composed of about 22 stout hairs. Ventral plate fulvous, finely serrate anteriorly and armed on its hind margin with a pair of stout, evenly curved, fulvous hooks pointing anteriorly. Lateral margin of terminal segment bordered with three rows of fine teeth, the anterior row rather stout with a very inconspicuous line of fine serrations at its base, the teeth of the two posterior rows irregular, long, slender, curved. Dorsal extremity with four finely plumose hairs.

Sayomyia rotundifolia n. sp.

Pl. 13, 40, fig. 2, 3; 2 respectively

This species is very close to S a y o m y i a a l b i p e s Johans., but differs in several particulars in both adult and larval stages, as will be seen by reference to descriptions.

A female was bred July 11 from larvae taken in a woodland pool at Karner and a second Aug. 2.

Description. *Female.* Labrum pale yellowish, margined with fuscous. Palpi rather slender, long, four segmented, somewhat fuscous, sparsely clothed with rather long, coarse hairs. Antennae straw yellow, the segments annulated with pale white; first segment globular, second elongated, both semitransparent, straw color. Frontal portion of head whitish, semitransparent; occiput with a median black spot, the lateral and posterior portions of head sparsely clothed with long, straw yellow hairs. Prothorax with a pair of broad, submedian, fulvous lines anteriorly and a similar pair of broader, sublateral ones posteriorly, inner margin of both stripes bordered by dark brown and outlined with a row of rather short, yellowish brown hairs, the area between the submedian and sublateral lines clothed with a rather broad row of coarse, brownish and yellowish hairs; the latter stripe is bordered laterally by a few coarse bristles, and the margin marked by several irregular, black specks. Scutellum light brown, crowned

with conspicuous rows of long, yellowish and brown hairs. Abdomen greenish yellow, finely spotted with fuscous, and with larger, black, irregular spots on the posterior portion of the segments, and on the antepenultimate these markings form a very irregular, basal band, the apical portion of the antepenultimate segment bearing a pair of subdorsal, irregular, black spots; terminal segment with a pair of sublateral, black spots, bearing a pair of straw yellow, somewhat elongate appendages. Pleura semitransparent, irregularly marked with black specks. Ventral surface of abdomen pale greenish yellow, with irregular, black spots about the middle of each segment. Halteres capitate, pedicel swollen, nearly colorless; apical portion semitransparent with a greenish tinge. Wings rather thickly clothed with straw yellow scales, being particularly abundant on the costal and subcostal veins. Petiole of first submarginal cell one third its length, that of second, one fourth. Posterior cross vein less than its length from mid cross vein. Legs uniform, straw yellow, rather sparsely clothed with long, somewhat coarse hairs.

Male. A specimen of this sex was bred from larvae taken in a woodland pool at Karner, an adult emerging July 7. Antennae thickly clothed with long, grayish yellow plumes; basal segment subglobose, yellowish; other segments semitransparent, annulate with brown. Palpi rather short, thickly clothed with dark brown, nearly black hairs, as is also true of the labium. Eyes jet black. Thorax with a slender, tapering, straw yellow, submedian stripe obsolete posteriorly and margined on the posterior half of the lateral border with dark brown. There is also a broad, lateral stripe margined internally, with dark brown. Scutellum pale yellow, bearing at its apex very long, brownish yellow hairs; postscutellum irregularly marked with brown. Abdomen semitransparent thickly clothed with yellowish hairs and with irregular, black markings at the anterior and lateral margins from the first to sixth segments inclusive; several dorsal black spots on the posterior abdominal segments. Ventral surface nearly unicolorous, semitransparent, whitish. Basal segment of clasp subcylindric, rather strongly curved, yellowish, and clothed with coarse, brownish yellow hairs. Apical segment brownish, black toward the tip, strongly curved. Legs nearly uniform, straw yellow, rather thickly clothed with long, yellowish hairs; ungues simple. Wings pale straw yellow, veins sparsely clothed with similarly colored scales; posterior fringe grayish. Petiole of first submarginal cell about one third its length, that of the second nearly half its length. Posterior cross vein about its own length from the mid cross vein. Halteres yellowish, capitate.

Pupa. The cast pupal skin has practically the same characteristics as those given for Sayomyia albipes Johans.

Larva. Head somewhat elongate, subconic; basal segment of antenna deeply notched at base and tipped with four nearly equal, tapering processes and one about half as long. Just behind the antenna are eight pale, long filaments, four on each side, the filaments of the third metamere of Meinert. Leaflike appendages extremely slender, rounding gradually anteriorly to a somewhat slender base. Posterior margin nearly straight, terminating in an extremely long pointed process, the latter being nearly half the entire length of the appendage; at its base, anteriorly, there are several rather large, irregular teeth. Labrum quadrate, elongate, obliquely truncate, tipped with an irregular tuft of stout hairs. Mandibles with three conspicuous teeth, the middle one with a small dentition near its base; there are two long, curved processes and two shorter, conical ones around the teeth proper. Mandibular fan composed of seven long, curved spines. Eyes deeply pigmented, as is also the case with the air sacks of the thoracic and seventh abdominal segments. Ventral tuft of terminal segment composed of about 16 rather stout, simple hairs. Ventral plate very pale fuscous, bearing stout, evenly curved hooks pointing anteriorly; lateral margin of terminal segment bordered with rows of inconspicuous teeth extremely difficult to detect. Dorsal tuft composed of four long, finely plumose hairs.

Sayomyia americana Johans.

This species occurs according to Johannsen in New York, New Jersey, Illinois and Minnesota. It was first characterized by him as a variety of S. plumicornis Fabr., but on comparison with European specimens, kindly sent us by Dr Meinert of Copenhagen, we conclude that Johannsen's form is entitled to specific rank. His description follows:

Male. Reddish brown; abdomen yellowish; the antennal joints yellow with brown tips, basal joint brown; the hairs pale brown; the front, the upper surface of the proboscis, and the palpal joints brown; the incisures of the latter yellow, the vertex, the cheeks and the underside of the proboscis and neck pale yellow; thorax pale brown above with three dark reddish brown stripes, the middle one divided by a fine, pale brown line; the lateral stripes abbreviated anteriorly, the median one posteriorly; the pectus and the margins of the pleural and jugular sclerites reddish brown; scutellum pale brown; metathorax dark brown; abdominal segments subequal in length except the first and last, which are less

than one half of the others. The dorsal surface is brown with pale yellow incisures. The brown coloring is darkest anteriorly, gradually becoming paler caudad, so that the posterior margin of the segment is almost as light in color as the incisure. This is particularly true with segments 3, 4 and 5. On segments 6, 7 and 8 the brown color is almost wanting excepting a triangular lateral spot which is prolonged caudad in a fine line. The outline of this spot, however, is not distinct, but is blended in with the color of the dorsum. A pair of very small pale yellow spots with a narrow brown border are more or less distinctly visible on each segment. The hypopygium consists of two jointed hooks, is pale brown in color, nearly as long as an abdominal segment . . . Venter and the legs are pale yellow, the last two or three tarsal joints slightly infuscated. Legs and abdomen densely but delicately haired; wings yellow-

Fig. 107 Leaflike appendages of the European Sayomyia plumicornis

Fig. 108 Labrum of the European S. plumicornis

ish, the veins scarcely dark . . . halteres pure white. Length $5\frac{1}{2}$ mm.

Female. Differs from the male in the following particulars. Antennae entirely yellow, basal joint, palpi and upper surface of proboscis with a tinge of brown; frontal spot brown; scutellum with a fine median line and its posterior margin pale yellow; abdomen yellow, dorsal surface with a tinge of brown, specially on the posterior margin. The two little white spots with pale brown margins also present on each segment. Anal segment brown, genitalia yellow, venter, legs, halteres, etc. as with the male . . . Length 5 mm.

Fig. 109 Leaflike appendages of S. americana

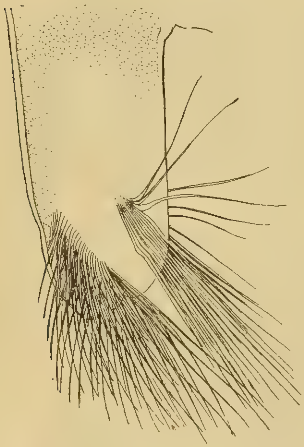


Fig. 110 Labrum of S. americana

Fig. 111 Ventral hooks of S. americana

Through the kindness of Dr Meinert we have been able to compare the larva described by Johannsen with the European form. It differs from the European S. plumicornis Fabr. in the following particulars. The four long appendages of the antennae are of equal length, while in the European form one is distinctly shorter than the rest; there is a marked difference in the leaflike appendages; and also in the ventral hooks of the last segment.

The larva has been described by Johannsen in detail in Museum bulletin 68. The pale yellow pupa resembles that of Culex.

Sayomyia hudsoni n. sp.

Pl. 13, 28, 40, 47, fig. 4, 5; 4; 1; 1 respectively

Larvae of this interesting species were taken in small numbers at Poughkeepsie June 17, and several males bred therefrom June 26 and 27.

Description. *Male.* Antennae thickly clothed with long, grayish black plumes. Basal segment subglobose, yellowish, other segments semitransparent, annulate with brown. Palpi short, thickly clothed with grayish brown hairs. Basal segment rather short, subconic; second about three times the length of the first and one fourth longer than the third; both stout, nearly uniform, except that the second has a distinct enlargement internally near the anterior fourth. Terminal segment slender, about twice the length of the third. Labrum ornamented with thick, brownish or silvery gray hairs. Eyes, jet black. Occiput and posterior portion of head yellowish, clothed with pale yellowish hairs. Thorax with submedian, slaty brown lines abbreviated posteriorly and divided by a slender, fulvous, median line, which latter is ornamented by a well defined, double row of long, yellowish hairs. Sublateral stripes of the same color, abbreviated anteriorly, and the space between the sublateral and submedian dark lines clothed with yellowish hairs arranged in more or less definite rows. Oval posterior portion of thorax and that between the sublateral lines, a uniform, pale brown with a median black spot at the posterior border. Pleura, anterior and lateral portions of thorax semitransparent, whitish. Scutellum prominent, with a few long, lateral bristles and its posterior surface ornamented with the brown bases of others with a slight median space naked. Postscutellum dark brown. Abdomen semitransparent, greenish or yellowish, obscure, irregular, somewhat variable, with lateral black markings at the posterior boundary of each segment; third, fourth and fifth segments with a pair of submedian, obscure, circular, whitish marks near the middle of each segment; sparsely clothed with long, yellowish hairs. Basal segment of clasp subcylindric, slightly curved, yellowish, with light brown markings internally and thickly clothed with long, yellowish hairs. Apical segment of clasp pale brownish yellow, nearly straight, terminating in an obscure point. Legs, uniform, straw yellow, rather thickly clothed with long, yellowish hairs; ungues simple. Wings, hyaline, anterior veins ornamented with pale straw yellowish scales, those of the other veins slightly darker. Petiole of first submarginal cell

Fig 112 Leaflike appendages of Sayomyia hudsoni

a little over one half its length; that of the second about three fourths its length, the cell being decidedly wider than the anterior one. Posterior cross vein less than its own length from the median cross vein. Halteres pale straw yellow.

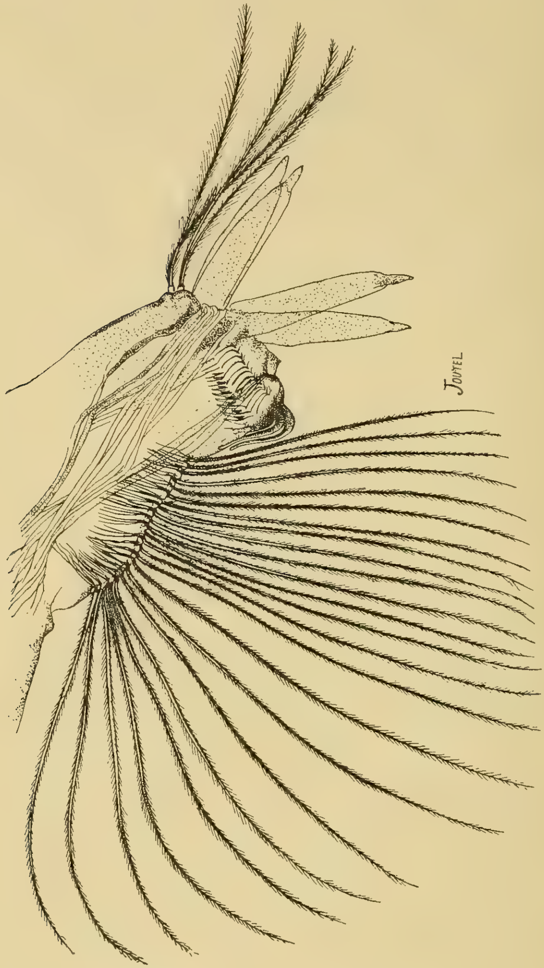


Fig. 113 Posterior extremity of S. hudsoni

A second male bred Aug. 5, differs in description in having the prothorax darker with lateral dark spots on the scutellum, jet black ones on the base of the wings; a broad, irregular, marginal white stripe anteriorly. Pleura also whitish with irregular, jet black spots. The anterior tarsi are somewhat darker than the tibiae.

Female. Antennae pale straw yellow, verticillate with a number of stout bristles arising from the base of each segment; basal

segment stout, subglobular, yellowish; second segment stout, somewhat swollen. Eyes jet black, very prominent, slightly emarginate anteriorly. Palpi rather short, grayish brown, and thickly clothed with hairs of the same color; basal joint thick, subconic, second slender, longer than the slightly stouter third, the fourth very slender, nearly twice the length of the preceding. Labrum yellowish white basally, the anterior margin dark brown and the dark color extending some distance on each side. Occiput and posterior portion of the head straw yellow, slightly darker on median line. Thorax with a pair of submedian, yellowish brown lines tapering posteriorly and becoming obsolete at the posterior third; narrow median line yellowish and with double row of yellow, slender scales. A sublateral, broad, yellowish stripe is present posteriorly and is separated from the submedian stripe and its opposite by a yellowish area thickly clothed with slender, yellowish scales; a small, black spot near the middle and a little to one side of the submedian stripes. Pleura and lateral anterior margin of prothorax and base of scutellum yellowish brown, posterior margin of latter thickly clothed with long, yellowish hairs. Abdomen greenish yellow and with irregular, sooty spots, particularly along the sublateral line, and clothed with rather short, pale hairs. Ventral surface similar, apical segment paler, terminal processes blunt, slightly curved, bearing many rather long, curved setae. Legs pale straw yellow, ungues simple. Wings pale straw yellow, clothed with similarly colored scales, which are slightly thicker along the anterior longitudinal veins. Petiole of first submarginal cell about one fourth its length, that of second nearly one half; posterior cross vein interstitial with mid cross vein. Halteres pale straw yellow, base somewhat enlarged, pedicel very slender, tip rounded, spatulate.

Described from a specimen bred June 28, 1904.

Pupa. Air tube with irregularly hexagonal cells, nearly four times as long as wide; internal margin nearly straight, outer, rather regularly curved and the apex distinct, chitinous, brown. Posterior two thirds of the inner margin of the inner paddle, fringed with long, nearly colorless spiny processes. Posterior appendages nearly conic, simple, and at their base an inconspicuous pair of subtriangular lobes.

The larva, remarkable on account of its transparency, is very difficult to detect in water, the only portions visible being the deeply pigmented eyes and air sacks in the thoracic and abdominal segments. This transparency is retained in alcoholic specimens and also in those mounted in balsam.

Larva. Head, somewhat elongate, subconic. Basal segment of antennae long, deeply notched at base and tipped with four nearly

equal, tapering processes and a smaller one about half as long. Just behind the antennae are 10 long, light brownish filaments, five on each side. These are the filaments of the third metamere of Meinert. The pair of leaflike appendages are rounded anteriorly to a narrow base, terminating in one large, posterior spine and a series of irregular ones along the nearly truncate apex. Labrum elongate, slightly curved, obliquely truncate and tipped with an irregular tuft of hairs. Maxillae subtriangular with a somewhat curved tip. Maxillary palpus slender, tapering, curved. Mandibles with three prominent and two minor teeth, posterior margin serrate. The conspicuous mandibular fans each consist of about 16 long, spinelike processes. Eyes, deeply pigmented. Air sacks of thoracic and seventh abdominal segments with many purplish, pigmented cells. The eversible pharynx with a circular, papillate tip or base bearing two lateral, stout, curved papillae. Ventral brush of terminal segment composed of about 24 stout hairs. Apical ventral plate fuscous, finely serrate anteriorly and bearing a pair of dark, stout hooks pointing anteriorly. Lateral margin of segment bordered with three rows of teeth, the anterior consisting of stout processes with almost inconspicuous, extremely fine serrations at their extreme base. The teeth of the two posterior rows are long, slender, curved. Dorsal extremity with four long, finely plumose hairs.

BIBLIOGRAPHY

The following list gives the more important references to the literature of the Culicidae, particularly to that treating of American forms.

1847 **Fitch, Asa.** Winter Insects of Eastern New York. Am. Jour. Agric. and Sci. 5:281–82. Reprinted N. Y. State Mus. 2d Ent. Rep't. 1885. p.241–42 (Anopheles punctipennis described as Culex hyemalis)

1868 **Osten Sacken, C. R.** Description of a New Species of Culicidae. Am. Ent. Soc. Trans. 2:47–48 (Aedes sapphirina described)

1877 ——— Western Diptera. U. S. Geol.–Geog. Sur. Bul. 3, p. 191 (Aedes fuscus described)

1881 **Dimmock, George.** Anatomy of the Mouth-parts and of the Suctorial Apparatus of Culex. Psyche, 3:231–41 (Detailed account)

1883 **King, A. F. A.** Insects and Disease-mosquitos and Malaria. Pop. Sci. Mo. 23:644–58 (Early evidence in favor of mosquitos conveying this disease)

1883 **Meinert, F. V. A.** Mochlonyx (Tipula) culiciformis DeG. Aftryk af Oversigt over d. K. D. Vidensk. Selsk. Forhandl. p.1–24.

1884 **Dimmock, G.** Psyche, 4:147 (Male Culex drinks)

1885 **Murray, C. H.** Young Trout Destroyed by Mosquitos. U. S. Fish Com. Bul. 5:243.

1886 **Meinert, F. V. A.** De Eucephale Myggelarver. Mem. de l'Acad. Royale de Copenhague. ser. 6. Class des Sci. v.3, no.4, p.373–434, 476–84 (Anatomic studies of the early stages of Culex annulatus, C. nemorosus, Anopheles maculipennis, Corethra plumicornis, Corethra pallida, Mochlonyx culiciformis)

1890 **Lamborn, R. H.** Dragon-flies against Mosquitos. Can the Mosquito Pest be Mitigated? p.1–202. D. Appleton & Co. (A series of essays by various authors)

1891 **Riley, C. V. & Howard, L. O.** Insect Life, 3:470 (Pyrethrum fumes for mosquitos)

1893 ——— Insect Life, 5:268 (Value of Eucalyptus in warding off mosquitos)

1894 ——— Insect Life, 6:327 (Kerosene and mutton tallow to protect animals from mosquitos)

1896 **Coquillett, D. W.** New Culicidae from North America. Can. Ent. 28:43–44 (Culex signifer, C. tarsalis and Megarhinus rutila described)

1896 **Ficalbi, Eugenio.** Rev. sistematica d. sp. d. fam. delle culicidae. Europee Soc. Ent. Ital. Bul. p.197–312.

1896 **Lintner, J. A.** The Mosquito. Ins. N. Y. 12th Rep't, p.319–35 (General discussion of mosquitos)

1896 **Lugger, Otto.** Minn. Exp. Sta. 2d Rep't, p.182–95 (General account with figures of the mosquitos of the state)

1896 **Osborn, Herbert.** Mosquitos. U. S. Dep't Agric. Div. Ent. Bul. 5, n. s. p.25–30 (Brief general account with special reference to C. pungens)

1899 **McDonald, Ian.** Mosquitos in Relation to Malaria. Brit. Med. Jour. 2020, Sep. 16, p.699 (Observations on transmission of malaria)

1899 **Nuttall, G. H. F.** On the Role of Insects, Arachnids and Myriapods as Carriers in the Spread of Bacterial and Parasitic Diseases of Man and Animals. Johns Hopkins Hosp. Rep'ts, 8:1–154.

1899 **Ross, Ronald.** Infection of Birds with Proteosoma by the Bites of Mosquitos. Indian Med. Gaz. 34:1–3 (Experiments showing birds to be infected with malaria by mosquito bites)

1900 **Giles, G. M.** Gnats or Mosquitos, p.1–374 (Structural and systematic account)

1900 **Howard, L. O.** Notes on the Mosquitos of the United States. U. S. Dep't Agric. Div. Ent. Bul. 25, n. s. p.1–70 (General account and key for separation of species, with biology of Culex pungens and Anopheles maculipennis. Remarks on other genera together with remedial measures)

1900 **Ross, Ronald.** Relationship of Malaria and the Mosquito. The Lancet, July 7, no.4010, p.48–50 (Observations on transmission of malaria)

1901 **Coquillett, D. W.** Three New Species of Culicidae. Can. Ent. 33:258–60 (Psorophora howardii, Culex curriei and Aedes smithii described)

1901 **Dyar, H. G.** Life History of Urantotaenia sapphirina O.S. N. Y. Ent. Soc. Jour. 9:179–82 (Life history with descriptions of egg, larval stages and pupa)

1901 **Howard, L. O.** Mosquitos, p.1–241. McClure, Phillips & Co. (Summary account of native species and discussion of methods of controlling, with tables for separation of species)

1901 **Nuttall, G. H. F., Cobbett, Louis & Strangeways-Pigg, T.** Studies in Relation to Malaria. Jour. of Hygiene, 1:4–44 (Extended studies on Anopheles and malaria)

1901 **Nuttall, G. H. F. & Shipley, Arthur E.** Structure and Biology of Anopheles. Jour. of Hygiene, 1:45–77, 451–84 (Detailed biologic and morphologic account)

1901 **Smith, J. B.** Some Notes on the Larval Habits of Culex pungens. Ent. News, 12:153–57 (Observations on Aedes smithii not C. pungens)

1901 ——— Ent. News, 12:254 (Note on Aedes smithii)

1901 **Theobald, F. V.** A Monograph of the Culicidae or Mosquitos (Two volumes and book of plates. General systematic account of the mosquitos of the world)

1901 **Wright, M. J.** The Resistance of the Larval Mosquito to Cold. British Med. Jour. Ap. 13, no.2102, p.882–83.

1902 **Berkeley, W. N.** Laboratory Work with Mosquitos, Pediatrics Laboratory, New York. p.1–112 (A laboratory guide)

1902 **Coquillett, D. W.** Three New Species of Nematocerous Diptera. Ent. News, 13:85 (Corethra brakeleyi described)

1902 ——— Three New Species of Culex. Can. Ent. 34:292–93 (Culex atropalpus, C. varipalpus and C. quadrivittatus described)

1902 ——— New Diptera from North America. U. S. Nat. Mus. Proc. 25:84–85 (Culex bimaculatus, C. fletcheri and C. squamiger described)

1902 ——— New Forms of Culicidae from North America. N. Y. Ent. Soc. Jour. 10:191–94 (The following genera and species are described: Corethrella, Anopheles eiseni, Culex dyari, C. melanurus and C. trivittatus)

1902 **Davis, G. C.** How Far May a Mosquito Travel? Ent. News, 12:185–86 (Records flight of 22 miles over desert)

1902 **Dyar, H. G.** Illustrations of the Larvae of North American Culicidae. N. Y. Ent. Soc. Jour. 10:194–201 (The following species are described: Culex canadensis, C. atropalpus, C. sylvestris, Aedes fuscus, Culex sollicitans, C. pipiens, C. melanurus, C. dyari, C. restuans, Corethra brakeleyi and C. trivittata)

1902 ——— Notes on Mosquitos on Long Island. Ent. Soc. Wash. Proc. 5:45–51 (The following species with table for separation of larvae are noticed: Anopheles crucians, A. punctipennis, A. maculipennis, Culex sollicitans, C. cantans, C. taeniorhynchus, C. pipiens, C. territans, Uranotaenia sapphirina)

1902 ——— The Eggs of Mosquitos of the Genus Culex. Science, 16:672–77 (Egg-laying habits of several species)

1902 **Lockhead, W.** Nature Study Lessons on Mosquitos. Ent. Soc. Ont. 32d Rept. 1901. p.94–98.

1902 **Ludlow, C. S.** Note on Culex annulatus. N. Y. Ent. Soc. Jour. 10:131 (Distribution)

1902 **Lutz, F. E. & Chambers, W. W.** North Shore Improvement Association. Rep't, p.1–26 (Discussion of habits and methods of control)
1902 **Morgan, H. A.** Observations upon the Mosquito, Conchyliastes musicus. U. S. Dep't Agric. Div. Ent. Bul. 37, n.s. p.113–15 (Life history, with figures of early stages)
1902 **Ross, Ronald.** Mosquito Brigades and How to Organize Them. p.1–98. George Philip & Son, Lond. (Methods of controlling mosquitos)
1902 **Smith, J. B.** Characters of some Mosquito Larvae. Ent. News, 13: 299–303 (Habits with illustrations of antennae and labial plates of the following species: Stegomyia signifer, Culex canadensis, C. cantans, C. sollicitans, C. taeniorhynchus, C. ? perturbans, C. confinis, C. triseriatus, C. atropalpus, C. sylvestris, C. territans, C. pungens, C. restuans, C. nigritulus and three unnamed species)
1902 ——— Concerning Certain Mosquitos. Science, 15: 13–15 (Observations on C. sollicitans and Anopheles)
1902 ——— Life History of Aedes smithii Coq. N. Y. Ent. Soc. Jour. 10: 10–15.
1902 ——— Mosquitos. N. J. Agric. Exp. Sta. Ent. Dep't. Rep't 1901, p.526–87 (Culex sollicitans, Anopheles and related species)
1902 ——— Notes on the Early Stages of Culex canadensis Theo. Ent. News, 13: 267–73.
1902 ——— Notes on the Early Stages of Corethra brakeleyi Coq. Can. Ent. 34: 139–40.
1902 ——— Practical Suggestions for Mosquito Control. N. J. Agric. Exp. Sta. Circ. May 16, p.1–4 (Gives law and a summarized statement of repressive measures)
1902 ——— The Mosquito Campaign in New Jersey. Science, 15: 898–900 (Brief statement of work proposed)
1902 ——— The Salt Marsh Mosquito Culex sollicitans Walk. Science, 16: 391–94 (Oviposition, hibernation of eggs, etc.)
1902 ——— The Salt Marsh Mosquito Culex sollicitans Walk. N. J. Agric. Exp. Sta. Spec. Bul. T, p.1–10 (Summary account of life history and methods of control)
1902 **Weeks, H. C., Davenport, C. B., Lutz, F. E. & Shaler, N. S.** North Shore Improvement Association, reports on plans for the extermination of mosquitos on the North Shore of Long Island between Hempstead Harbor and Cold Spring Harbor, p.1–124. (Detailed reports on the practical work, with discussions of important species)
1903 **Adams, C. F.** Dipterological Contributions. Univ. Kan. Sci. Bul. 2, p.25–27 (Descriptions of Culex affinis, C. apicalis and C. particeps)
1903 **Aldrich, J. M.** Do We Know Culex consobrinus? Can. Ent. 35: 208–10 (Discussion of identity)
1903 **Chambers, W. W.** Mosquito Extermination on North Shore of Long Island, p.1–22 (Local observations and method of control)
1903 **Coquillet, D. W.** Culex consobrinus Again. Can. Ent. 35: 218 (Synonymy)

1903 ——— Four New Species of Culex. Can. Ent. 35:255–57 (Culex cantator, C. aurifer, C. nanus and C. discolor described)

1903 ——— Eucorethra, a Genus of Culicidae. Can. Ent. 35:272.

1903 ——— A New Culicid Genus Related to Corethra. Can. Ent. 35:189–90 (Sayomyia proposed and Corethra cinctipes described)

1903 ——— A New Anopheles with Unspotted Wings. Can. Ent. 35:310 (Anopheles barberi described)

1903 Dyar, H. G. Culex restuans Theo. Ent. News, 14:41–42 (Description of adult, early stages, habits)

1903 ——— Illustrations of the Larvae of North American Culicidae—III. N. Y. Ent. Soc. Jour. 11:23–27 (Larvae of the following are described: Culex taeniorhynchus, C. nigritulus, C. consobrinus, C. triseriatus, C. signifer and C. bimaculatus)

1903 ——— Notes on Mosquitos in New Hampshire. Ent. Soc. Wash. Proc. 5:140–48 (Notes on the following species: Anopheles punctipennis, A. maculipennis, Culex canadensis, C. reptans, C. cantans, C. sylvestris, C. territans, C. triseriatus, C. melanurus, C. dyari, C. restuans, C. pipiens, C. atropalpus, C. perturbans, C. sollicitans, Uranotaenia sapphirina, Aedes fuscus, with table for separation of the species and illustrations of the labial plates of larvae)

1903 Felt, E. P. Mosquitos. N. Y. State Mus. Cir. p.1–8 (Brief summarized account)

1903 Harris, H. F. The Eggs of Psorophora ciliata. Ent. News, 14:232–33

1903 Herrick, G. W. The Relation of Malaria to Agriculture and Other Industries of the South. Pop. Sci. Mo. 52:521–25 (Economic losses occasioned by malaria)

1903 Johannsen, O. S. Culicinae. N. Y. State Mus. Bul. 68, p.388–429. (Also published separately, Aug. 11, 1903. Detailed systematic accounts of the following genera and species: Corethra, C. appendiculata, C. plumicornis, C. punctipennis, C. trivittata, C. albipes; Corethrella, C. brakeleyi; Pelorempis, P. americana; Anopheles, A. punctipennis, A. maculipennis; Psorophora and Culex, with a table for separation of larvae, C. restuans, C. pipiens, C. cantans, C. sylvestris, C. triseriatus; Aedes, A. fuscus, A. smithii, Uranotaenia and U. sapphirina)

1903 Morgan, H. A. & Dupree, J. W. Development and Hibernation of Mosquitos. U. S. Dep't Agric. Div. Ent. Bul. 40, n.s. p.88–92.

1903 Mosquito Extermination in Practice. Lawrence, L. I. Bd Health. Rep't, p.1–42 (Discussion of conditions and practical methods of controlling, with special mention of Culex sollicitans, C. pipiens and Anopheles)

1903 Pettit, R. H. Mosquitos and Other Insects of the Year 1902. Michigan Bd. Agric. 42d Rep't of Secretary, p.252–63 (General observations with list of native species and discussion of general repressive measures, with notice of a fungous disease)

1903 **Robinson, W. F.** Study of the Mosquito Pest in Elizabeth N. J. p.1–15 (Report of practical operations with notes on the following species: Culex canadensis, C. cantans, C. territans, C. pungens, C. pipiens, C. sylvestris, C. sollicitans, Psorophora ciliata and Anopheles punctipennis)

1903 **Smith, J. B.** Concerning Mosquito Migrations. Science, 18:761–64 (Migratory powers of C. sollicitans and C. cantator with mention of related species)

1903 ——— Contribution Toward a Knowledge of the Life History of Culex sollicitans. Psyche, 10:1–6 (Detailed account with illustrations of all stages)

1903 ——— Mosquitocides for Mosquitos. U. S. Dep't Agric. Div. Ent. Bul. 40, n.s. p.96–108.

1903 ——— Notes on Culex serratus Theob. and its Early Stages. Ent. News, 14:309–11.

1903 ——— Report on the Mosquito Investigations. N. J. Agric. Exp. Sta. Ent. Div. Rep't, 1902. p.511–93 (General account of work with special reference to C. sollicitans and Anopheles)

1903 **Snow, F. H.** Preliminary List of the Diptera of Kansas. Univ. Kan. Sci. Bul. 2, p.211–12 (List of Culicidae)

1903 **Theobald, F. V.** A Monograph of the Culicidae or Mosquitos. 3:1–359 (Supplementary to preceding volumes)

1903 ——— Notes on Culicidae and their Larvae from Pecos, New Mexico, and Description of a New Grabhamia. Can. Ent. 35:311–16 (Notes on Theobaldia incidens, Culex kelloggii, C. consobrinus, Grabhamia curriei and G. vittata, the latter described, the larva figured, together with the larva of C. kelloggii)

1903 **Underwood, W. L.** A New Mosquito. Science, 18:182–84 (Notes on the larva of Eucorethra underwoodi)

1903 ——— Mosquitos and Suggestions for their Extermination. Pop. Sci. Mo. 53:453–66 (Brief general account, with mention of various species, particularly Anopheles maculipennis, Stegomyia fasciata, Culex sollicitans and Eucorethra underwoodi)

1903 **Weeks, H. C.** Some Practical Suggestions on Mosquito Extermination in New Jersey. Reprint from Med. News, Mar. 7, 1903, p.1–17.

1903 ——— Summary Report on the Sanitary-economic Improvement of the Southern Part of the Borough of Brooklyn, p.1–24.

1903 ——— The Concurrence of the Anopheles Mosquito and Malaria. N. Y. State Jour. Med. 3:272–75.

1904 **Coquillett, W. F.** Notes on Culex nigritulus. Ent. News, 15:73–74 (C. salinarius proposed)

1904 ——— Several New Diptera from North America. Can. Ent. 36:10–11 (Culex dupreei and Conchyliastes varipes described)

1904 ——— New North American Diptera, family Culicidae. Ent. Soc. of Wash. Proc. 6:166–69 (Taeniorhynchus nigricans, T. signipennis, Culex nivitarsis and C. pullatus described, the first from Panama, the second from Mexico)

1904 **Dyar, H. G.** Notes on the Mosquitos of British Columbia. Ent. Soc. Wash. Proc. 6:37–41 (Biologic notes on the following species:

Culex impiger, C. cantans, C. reptans, C. canadensis, C. incidens, C. punctor, C. sylvestris, C. varipalpus, C. territans, C. dyari, C. tarsalis, C. perturbans, C. curriei, C. spencerii, C. consobrinus, Anopheles maculipennis, Aedes fuscus)

1904 ——— Notes on the Mosquitos of British Columbia; continued (Corethra velutina, Sayomyia trivittata and Eucorethra underwoodi)

1904 ——— The Life History of Culex cantans Meig. [C. vittatus] N. Y. Ent. Soc. Jour. 12:36–38.

1904 ——— The Life History of Culex varipalpus Coquillett. N. Y. Ent. Soc. Jour. 12:90–99.

1904 ——— Brief Notes on Mosquito Larvae. N. Y. Ent. Soc. Jour. 12:172–74 (Notes on the following species: Culex dyari, C. atropalpus, C. aurifer, C. discolor, Janthinosoma musicum, C. salinarius, C. vittatus, C. cantans and C. reptans)

1904 ——— Larva of Culex punctor Kirby with Notes on an Allied Form. N. Y. Ent. Soc. Jour. 12:169–71 (Description of larva of Culex punctor Kirby and early stages of C. trichurus Dyar)

1904 **Dyar, H. G. & Knab, Frederick.** Diverse Mosquito Larvae that Produce Similar Adults. Ent. Soc. Wash. Proc. 6:143–44 (Observations on differences in larvae referred to Culex cantans, C. restuans and C. impiger recorded)

1904 **Felt, E. P. & Young, D. B.** Importance of Isolated Rearings from Culicid Larvae. Science, 20:312–13 (Brief description of larvae and adults of the following new species: Culex cinereoborealis, C. lazarensis, C. abserratus and C. fitchii)

1904 **Herrick, G. W.** Notes on the Life History of Grabhamia jamaicensis. Ent. News, 15:81–84.

1904 **Johnson, C. W.** Supplementary List of the Diptera of New Jersey. Ent. News, 15:157–58 (List of Culicidae)

1904 **Knab, Frederick.** The Epistomal Appendages of Mosquito Larvae. N. Y. Ent. Soc. Jour. 12:175–77.

1904 **Ludlow, C. S.** Mosquito Notes No. 2. Can. Ent. 36:297–301 (Mimomyia chamberlaini and Myzomyia rossi var. indefinita described)

1904 **Smith, J. B.** Notes on the Life History of Culex dupreei Coq. Ent. News, 15:49–51 (Observations with illustrations of all stages)

1904 ——— Notes on Some Mosquito Larvae Found in New Jersey. Ent. News, 15:145–52 (Larvae of the following are described and figured: Culex trivittatus, C. discolor, C. aurifer and Anopheles crucians)

1904 ——— The Common Mosquitos of New Jersey. N. J. Agric. Exp. Sta. p.1–40 (Brief, general account with illustrations of Culex pipiens, C. restuans, C. sollicitans, C. taeniorhynchus, C. cantator, C. salinarius, C. cantans, C. territans, C. sylvestris, C. canadensis, Anopheles maculipennis, A. punctipennis, A. crucians and Psorophora ciliata. A table for the sepa-

ration of the species occurring in the state and of certain larval forms is also given)

1904 ——— Report on the Mosquito Investigation. Agr. Exp. Sta. Rep't. Ent. Dep't, 1903, p.645–59 (Summarized statement of work together with list of species taken in the state)

1904 **Snow, F. H.** List of Diptera. Univ. Kan. Sci. Bul. 2, p.341 (List of Kansas Culicidae)

1904 **Theobald, F. V.** Mosquito Annoyance at Woodford (Essex) and Elsewhere. 2d Rep't on Economic Zoölogy, p.2–16 (Observations on various mosquitos, specially Theobaldia annulata Meig., with illustrations of pupa and larva of the latter

1904 **Van Dine, D. L.** Mosquitos in Hawaii. Agr. Exp. Sta. of Haw. Bul. 6, p.1–30 (Common Hawaiian forms, Culex pipiens, Stegomyia fasciata and S. scutellaris treated, with discussion of control)

1904 **Wesche, W.** The Mouth-parts of the Nematocera and their Relation to the other Families in Diptera. Roy. Micro. Soc. Jour. p.31, 33, 35–36 (Discussion with illustrations of the mouth parts of various mosquitos)

1904 First General Convention to Consider the Questions Involved in Mosquito Extermination. Proc. Dec. 16, 1903, p.1–84.

The following is a list of the important papers:

Smith, J. B. How a State Appropriation May Be Spent, p.13-15.
Kerr, W. C. What a Rural Community Can Do, p.16-18.
Howard, L. O. The World-wide Crusade, p.19-21.
Matheson, W. J. Does Extermination Exterminate Mosquitos? p.21-24.
Claflin, John. Remarks upon Extermination Work at Morristown, N. J., p.24-25.
Bailhache, P. W. The Extermination and Exclusion of Mosquitos From Our Public Institutions, p.27-30.
Perry, J. C. Government Anti-Mosquito Work, p.31-33.
Lederle, E. J. The Sphere of Health Departments, p.34-35.
Berkeley, W. N. The Exactness of Proofs of Transmission of Malaria by Mosquitos, p.35-39.
Miller, Spencer. The Long Distance Theory, p.42-44.
Whitney, Milton. Value of Reclaimed Swamp Lands for Agricultural Uses, p.46-48.
Gorgas, W. C. Anti-Mosquito Work in Havana, p.48-50.
Cravath, P. D. How the Law Should Aid, p.50-51.
Felt, E. P. New York State's Part in Mosquito Extermination, p.52-55.
Beach, F. C. What the General Government Should Do, p.55-56.
Weeks, H. C. Mosquito Engineering, p.59-61.

ADDENDUM

Culex abfitchii n. sp.

Larvae of this species were taken in some numbers at Karner N. Y. in early May, in association with those of C. fitchii, which latter they closely resemble in general form and structure but may be separated therefrom by the one or two isolated pecten teeth on the air tube, and by the large apical spine of the comb scales being from one half to two thirds the length of the entire structure [pl. 41, 48, fig. 3, 4]. This is the larva which Messrs Dyar and Knab consider the normal form of Culex cantans Meig. [Ent. Soc. Wash. Proc. 6:143]. This species proved difficult to rear, though a number of larvae were obtained.

EXPLANATION OF PLATES[1]

Plate 1

1 Female wing of Anopheles punctipennis. x 21
2 Female wing of A. punctipennis var. x 21
3 Male wing of A. punctipennis var. x 21
4 Female wing of A. maculipennis. x 21
5 Male wing of A. maculipennis. x 21

Plate 2

1 Female wing of Psorophora ciliata. x 11
2 Male wing of P. ciliata. x 14
3 Female wing of Janthinosoma musica. x 21
4 Female wing of Culex fitchii. x 21

Plate 3

1 Male wing of Culex fitchii. x 21
2 Female wing of C. cantans. x 21
3 Male wing of C. cantans. x 21
4 Female wing of C. sylvestris. x 21
5 Male wing of C. sylvestris. x 21

Plate 4

1 Female wing of Culex cantator. x 21
2 Male wing of C. cantator. x 21
3 Female wing of C. sollicitans. x 21
4 Male wing of C. sollicitans. x 21
5 Female wing of C. taeniorhynchus. x 21

Plate 5

1 Male wing of Culex taeniorhynchus. x 21
2 Female wing of C. onondagensis. x 21
3 Male wing of C. canadensis. x 21
4 Female wing of C. canadensis. x 21
5 Female wing of C. atropalpus. x 21

Plate 6

1 Male wing of Culex atropalpus. x 21
2 Female wing of C. territans. x 21

---

[1] Reproduced from author's photomicrographs of balsam mounts prepared by D. B. Young.

3 Male wing of C. territans. x 21
4 Female wing of C. lazarensis. x 21
5 Male wing of C. lazarensis. x 21

Plate 7

1 Female wing of Culex cinereoborealis. x 21
2 Male wing of C. cinereoborealis. x 21
3 Female wing of C. impiger. x 21
4 Male wing of C. impiger. x 21

Plate 8

1 Female wing of Culex absobrinus. x 20
2 Male wing of C. absobrinus. x 21
3 Female wing of C. magnipennis. x 20
4 Male wing of C. magnipennis. x 21

Plate 9

1 Portion of female wing of Culex consobrinus. x 21
(From photograph of an unmounted wing)
2 Female wing of C. restuans. x 21
3 Male wing of C. restuans. x 21
4 Female wing of C. pipiens. x 21
5 Male wing of C. pipiens. x 21

Plate 10

1 Male wing of Culex dyari. x 21
2 Wing of C. abserratus. x 21
3 Female wing of C. salinarius. x 21
4 Male wing of C. salinarius. x 21
5 Female wing of C. triseriatus. x 21

Plate 11

1 Female wing of Culex aurifer. x 21
2 Male wing of C. aurifer. x 21
3 Female wing of Taeniorhynchus perturbans. x 21
4 Female wing of Aedes fuscus. x 21
5 Male wing of A. fuscus. x 21

Plate 12

1 Male wing of Uranotaenia sapphirina. x 30.
2 Female wing of Eucorethra underwoodi. x 8
3 Male wing of E. underwoodi. x 13
4 Female wing of Sayomyia trivittata. x 21

Plate 13

1 Male wing of Sayomyia trivittata. x 21
2 Female wing of S. rotundifolia. x 21
3 Male wing of S. rotundifolia. x 21
4 Female wing of S. hudsoni. x 21
5 Male wing of S. hudsoni. x 21

Plate 14

1 Portion[1] of female wing of Anopheles punctipennis. x 110
2 Portion of male wing of A. punctipennis. x 110
3 Portion of female wing of A. maculipennis. x 110
4 Portion of male wing of A. maculipennis. x 110

Plate 15

1 Portion of female wing of Psorophora ciliata. x 110
2 Portion of female wing of Janthinosoma musica. x110
3 Portion of female wing of Culex fitchii. x 110
4 Portion of male wing of C. fitchii. x 110

Plate 16

1 Portion of female wing of Culex cantans. x 110
2 Portion of male wing of C. cantans. x 110
3 Portion of female wing of C. sylvestris. x 110
4 Portion of male wing of C. sylvestris. x 110

Plate 17

1 Portion of female wing of Culex cantator. x 110
2 Portion of male wing of C. cantator. x 110
3 Portion of female wing of C. onondagensis. x110
4 Portion of female wing of C. sollicitans. x 110

---

[1]The region of the cross veins is the part selected in all cases where not otherwise stated.

Plate 18

1 Portion of male wing of *Culex sollicitans*. x110
2 Portion of female wing of *C. taeniorhynchus*. x110
3 Portion of male wing of *C. taeniorhynchus*. x110
4 Portion of female wing of *C. canadensis*. x110

Plate 19

1 Portion of male wing of *Culex canadensis*. x110
2 Portion of female wing of *C. atropalpus*. x110
3 Portion of male wing of *C. atropalpus*. x110
4 Portion of female wing of *C. territans*. x110

Plate 20

1 Portion of male wing of *Culex territans*. x110
2 Portion of female wing of *C. lazarensis*. x110
3 Portion of male wing of *C. lazarensis*. x110
4 Portion of male wing of *C. cinereoborealis*. x110

Plate 21

1 Portion of female wing of *Culex cinereoborealis*. x110
2 Portion of female wing of *C. impiger*. x110
3 Portion of male wing of *C. impiger*. x110
4 Portion of male wing of *C. dyari*. x110

Plate 22

1 Portion of female wing of *Culex absobrinus*. x110
2 Portion of male wing of *C. absobrinus*. x110
3 Portion of female wing of *C. magnipennis*. x110

Plate 23

1 Portion of male wing of *Culex magnipennis*. x110
2 Portion of female wing of *C. restuans*. x110
3 Portion of male wing of *C. restuans*. x110
4 Portion of female wing of *C. pipiens*. x110

Plate 24

1 Portion of male wing of *Culex pipiens*. x110
2 Portion of female wing of *C. abserratus*. x110

3 Portion of female wing of C. salinarius. x 110

4 Portion of male wing of C. salinarius. x 110

Plate 25

1 Portion of female wing of Culex triseriatus. x 110

2 Portion of female wing of C. aurifer. x 110

3 Portion of male wing of C. aurifer. x 110

4 Portion of wing fringe of female Anopheles maculipensis. x 110

Plate 26

1 Portion of female wing fringe of Culex cinereoborealis. x 110

2 Portion of female wing fringe of C. pipiens. x 110

3 Portion of female wing of Taeniorhynchus perturbans. x 110

4 Portion of female wing of Aedes fuscus. x 110

Plate 27

1 Portion of male wing of Aedes fuscus. x 110

2 Portion of female wing of Uranotaenia sapphirina. x 110

3 Portion of fifth longitudinal vein of female wing of U. sapphirina, x 110, showing the orbicular finely striated violet scales

4 Portion of female wing of Corethra lintneri. x 110

Plate 28

1 Portion of female wing of Corethra cinctipes. x 110

2 Portion of female wing of Eucorethra underwoodi. x 110

3 Portion of female wing of Sayomyia trivittata. x 110

4 Portion of female wing of S. hudsoni. x 110

Plate 29

1 Male genitalia of Anopheles punctipennis. x 110

2 Male genitalia of A. maculipennis. x 110

Plate 30

1 Male genitalia of *Psorophora ciliata*. x 55

2 Male genitalia of *Culex cantans*. x 80

Plate 31

1 Male genitalia of *Culex sylvestris*. x 110

2 Male genitalia of *C. cantator*. x 110

Plate 32

1 Male genitalia of *Culex sollicitans*. x 110

2 Male genitalia of *C. atropalpus*. x 110

Plate 33

1 Male genitalia of *Culex taeniorhynchus*. x 110

2 Male genitalia of *C. aurifer*. x 80

Plate 34

1 Male genitalia of *Culex territans*. x 110

2 Appendages of basal segment of clasp of *C. territans*. x 240

3 Male genitalia of *C. canadensis*. x 110

Plate 35

1 Male genitalia of *Culex dyari*. x 110

2 Male genitalia of *C. lazarensis*. x 110

Plate 36

1 Male genitalia of *Culex impiger*. x 110

2 Male genitalia of *C. cinereoborealis*. x 80

Plate 37

1 Male genitalia of *Culex absobrinus*. x 65

2 Male genitalia of *C. magnipennis*. x 65

Plate 38

1 Male genitalia of *Culex restuans*. x 110

2 Appendages of basal segment of clasp of *C. restuans*. x 240

3 Male genitalia of C. pipiens. x 80

4 Male genitalia of C. pipiens, showing dissected clasp. x 110

5 Appendages of basal segment of clasp of C. pipiens. x 240

Plate 39

1 Male genitalia of Culex salinarius. x 110

2 Appendages of basal segment of clasp of C. salinarius. x 240

3 Male genitalia of Aedes fuscus. x 110

4 Male genitalia of Eucorethra underwoodi. x 55

Plate 40

1 Male genitalia of Sayomyia hudsoni. x 110

2 Male genitalia of S. rotundifolia. x 110

Plate 41

1 Air tube of Psorophora ciliata. x 30

2 Air tube of Culex fitchii. x 55

3 Air tube of C. abfitchii. x 55

4 Air tube of C. cantans. x 55

Plate 42

1 Air tube of Culex taeniorhynchus. x 45

2 Air tube of C. sollicitans. x 45

3 Air tube of C. cantator. x 45

4 Air tube of C. canadensis. x 45

5 Air tube of C. sylvestris. x 45

Plate 43

1 Air tube of Culex impiger. x 45

2 Air tube of C. lazarensis. x 45

3 Air tube of Aedes fuscus. x 45

4 Air tube of Culex dyari. x 45

5 Air tube of C. salinarius. x 45

6 Air tube of C. territans. x 45

Plate 44

1 Air tube of Culex pipiens. x 55

2 Air tube of C. *jamaicensis*. x25
3 Air tube of C. *restuans*. x45
4 Air tube of C. *serratus*. x55
5 Air tube of C. *atropalpus*. x80

Plate 45

1 Air tube of *Culex cinereoborealis*. x55
2 Air tube of C. *abserratus*. x45
3 Air tube of C. *magnipennis*. x45
4 Air tube of C. *absobrinus*. x45

Plate 46

1 Air tube of *Culex melanurus*. x45
2 Air tube of *Uranotaenia sapphirina*. x30
3 Air tube of *Culex dupreei*. x45
4 Air tube of C. *discolor*. x45
5 Air tube of C. *aurifer*. x45
6 Air tube of C. *triseriatus*. x45

Plate 47

1 Larva of *Sayomyia hudsoni*. x9 (Reproduced from photomicrograph by Joseph McKay, Troy)
2 Air sack of S. *albipes*. x110
3 Air tube of *Eucorethra underwoodi*. x21

Plate 48

1 Comb of *Anopheles punctipennis*. x110
2 Comb of A. *maculipennis*. x110
3 Comb of *Culex fitchii*. x110
4 Comb of C. *abfitchii*. x110
5 Comb of C. *discolor*. x110
6 Comb of C. *melanurus*. x110
7 Comb of *Uranotaenia sapphirina*. x110

Plate 49

1 Comb of *Culex sylvestris*. x110
2 Comb of C. *cantator*. x240
3 Comb of C. ?*cantans*. x240

Plate 50

1 Comb of Culex cantans, normal form about Albany. x 240

2 Comb of C. canadensis. x 240

3 Comb of C. sollicitans. x 240

Plate 51

1 Comb of Culex magnipennis. x 240

2 Comb of C. absobrinus. x 240

3 Comb of C. lazarensis. x 240

Plate 52

1 Comb of Culex impiger. x 110

2 Comb of C. aurifer. x 110

3 Comb of Aedes fuscus, x 110, portion of one scale sketched in

4 Comb of Culex serratus. x 110

5 Comb of C. cinereoborealis. x 110

Plate 53

1 Comb of Culex taeniorhynchus. x 240

2 Comb of C. restuans. x 240

3 Comb of C. pipiens. x 240

4 Comb of C. salinarius. x 240

5 Comb of C. triseriatus. x 240

6 Comb of C. dupreei. x 110

Plate 54

1 Comb of Culex dyari. x 220

2 Comb of C. atropalpus. x 240

Plate 55

1 Labial plate of Culex cinereoborealis larva. x 220

2 Labial plate of C. magnipennis larva. x 220

3 Labial plate of C. atropalpus larva. x 220

4 Labial plate of C. dyari larva. x 220

5 Labial plate of C. aurifer larva. x 220

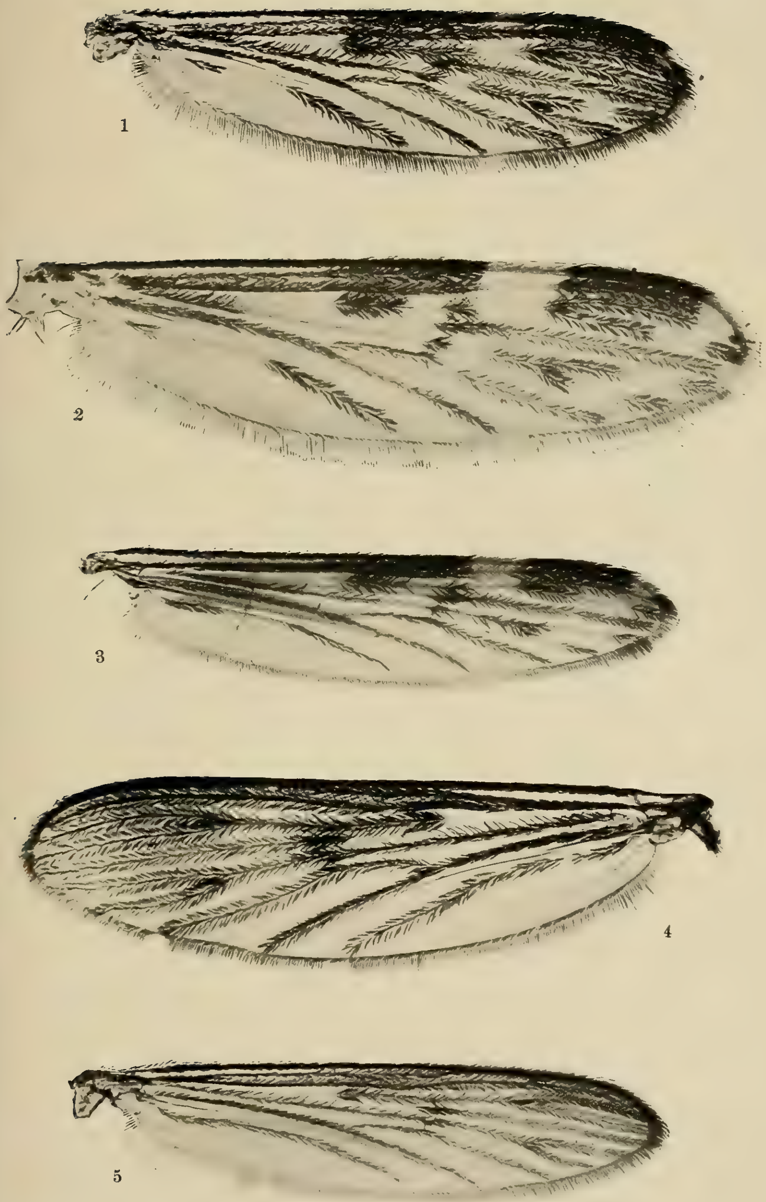
Plate 56

1 Male genitalia of Janthinosoma musica. x110
2 Male genitalia of Culex jamaicensis. x110

Plate 57

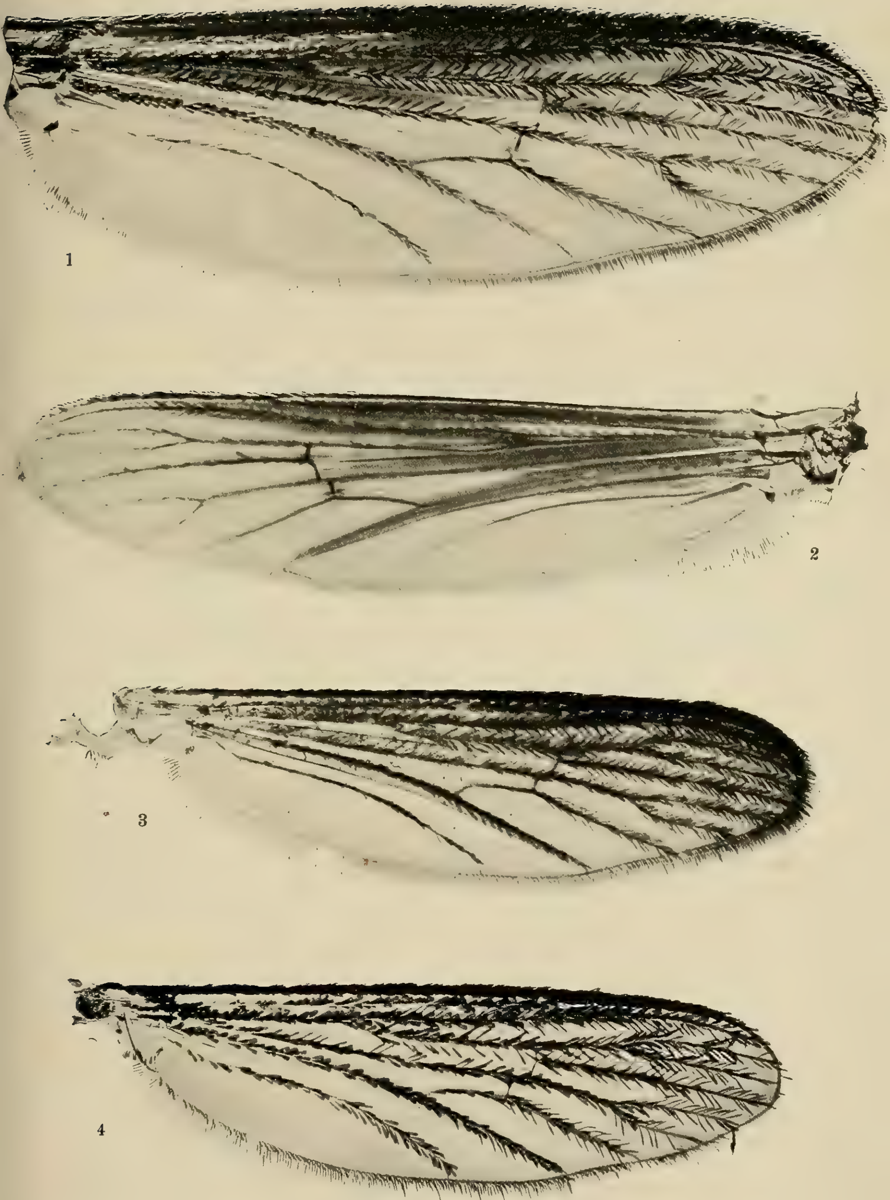
1 Male genitalia of Culex melanurus. x110
2 Male genitalia of C. triseriatus. x110

Plate 1



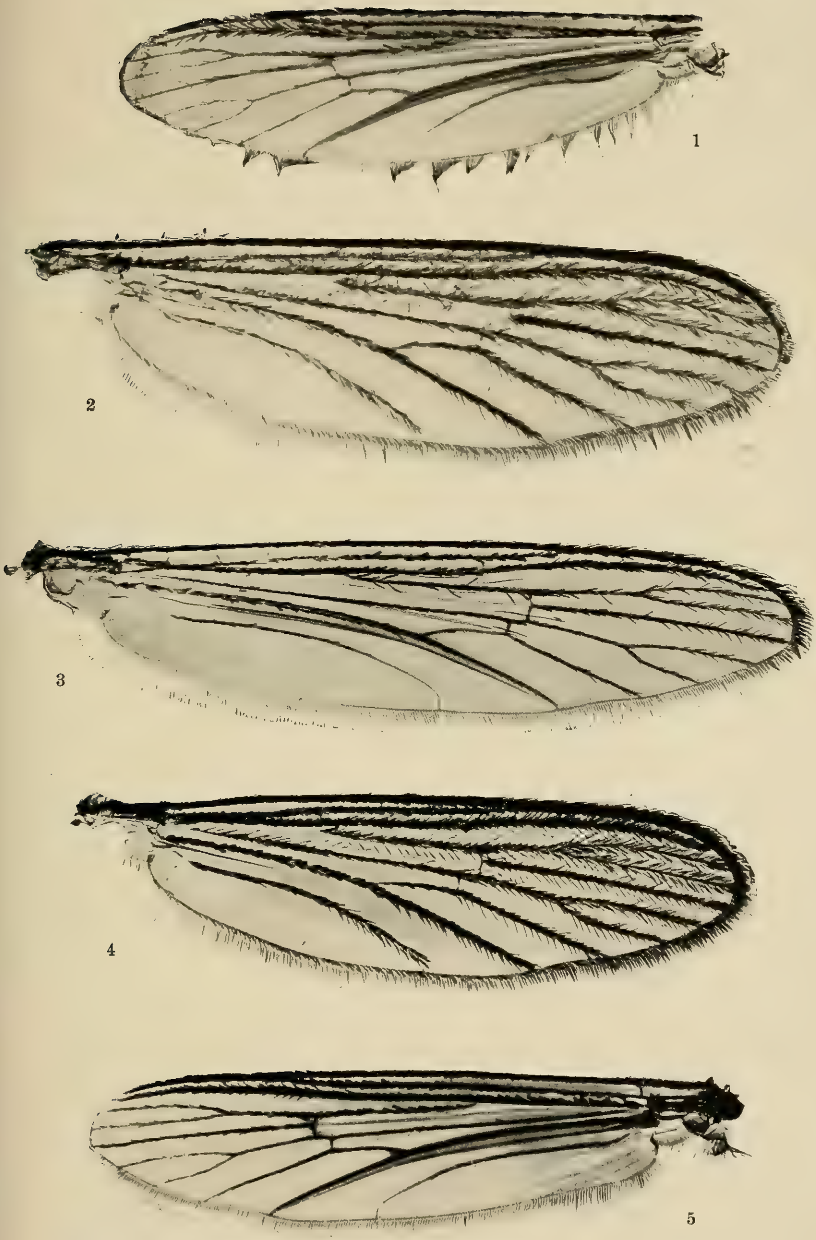
1-3 Anopheles punctipennis. 4,5 A. maculipennis

Plate 2



1,2 Psorophora ciliata. 3 Janthinosoma musica
4 Culex fitchii

Plate 3

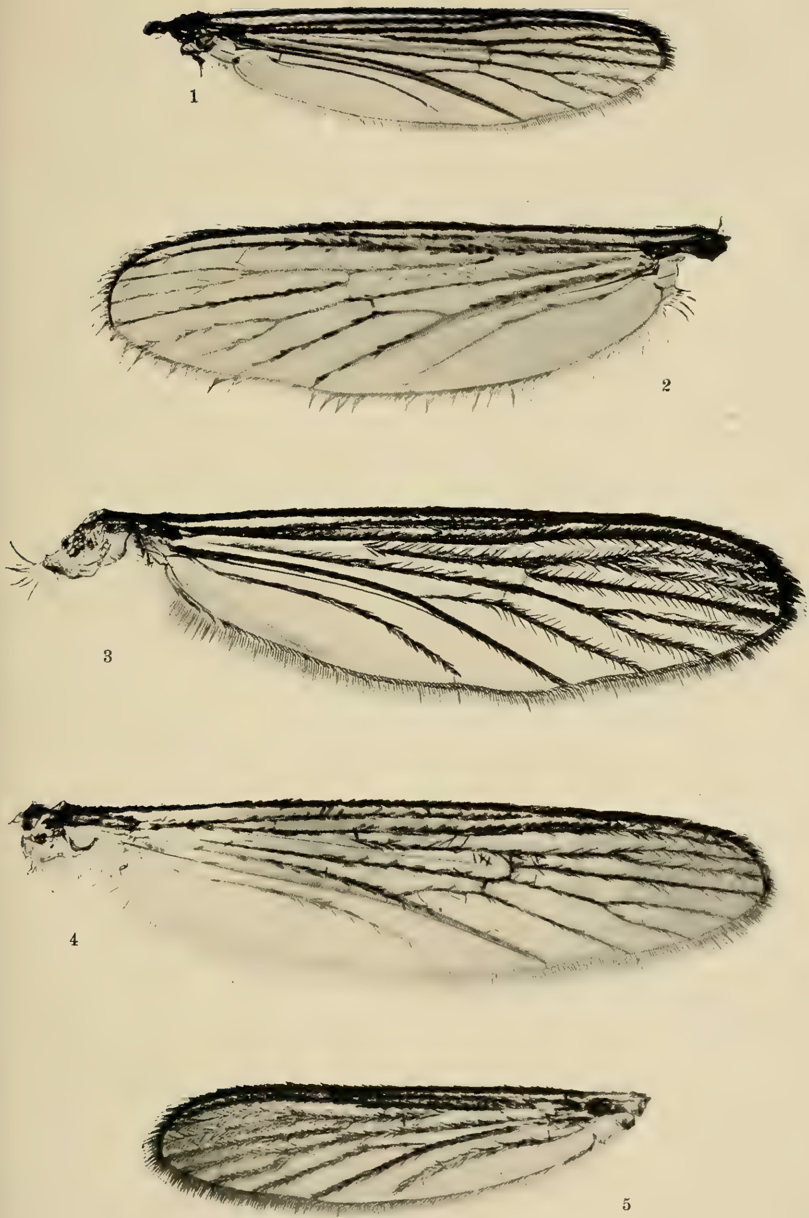


1 Culex fitchii. 2,3 C. cantans. 4,5 C. sylvestris

Plate 4

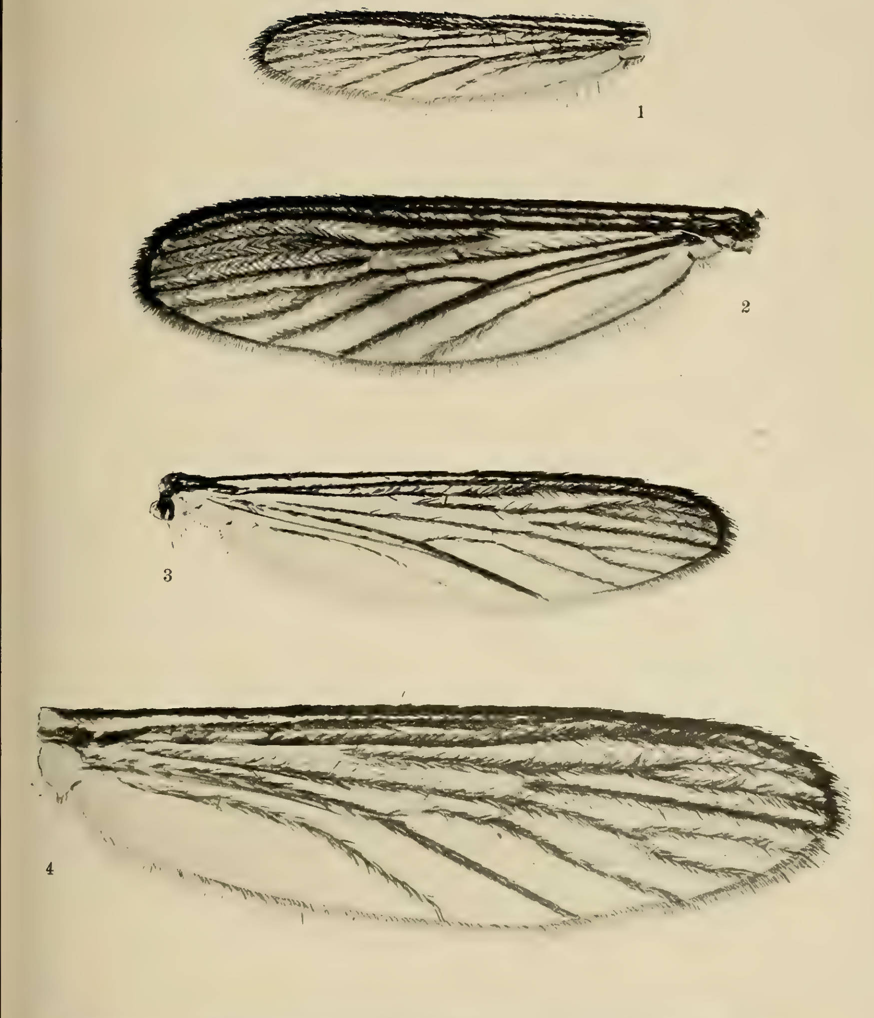
1,2 Culex cantator. 3,4 C. sollicitans
5 C. taeniorhynchus

Plate 5



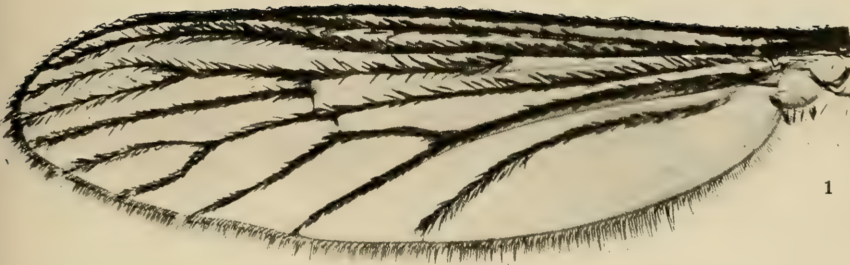
1 Culex taeniorhynchus. 2 C. onondagensis
3, 4 C. canadensis. 5 C. atropalpus

Plate 6

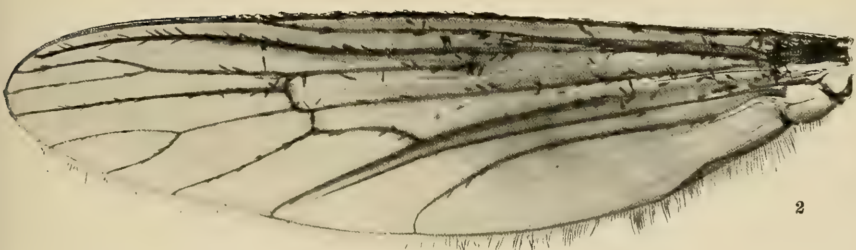


1 Culex atropalpus. 2, 3 C. territans. 4, 5 C. lazarensis

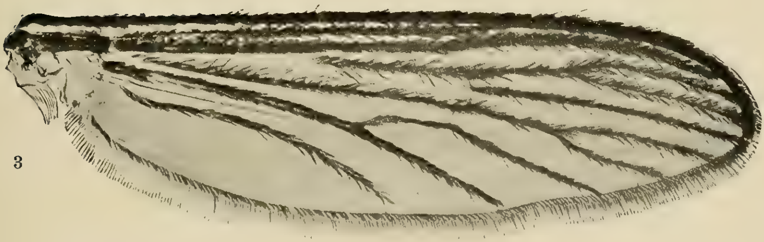
Plate 7



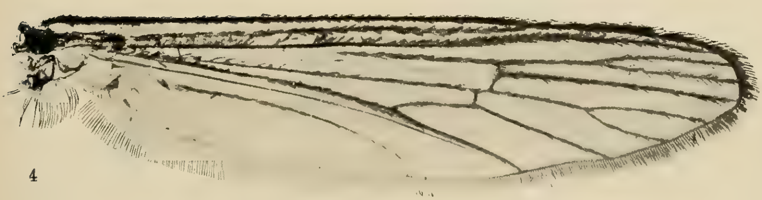
1



2



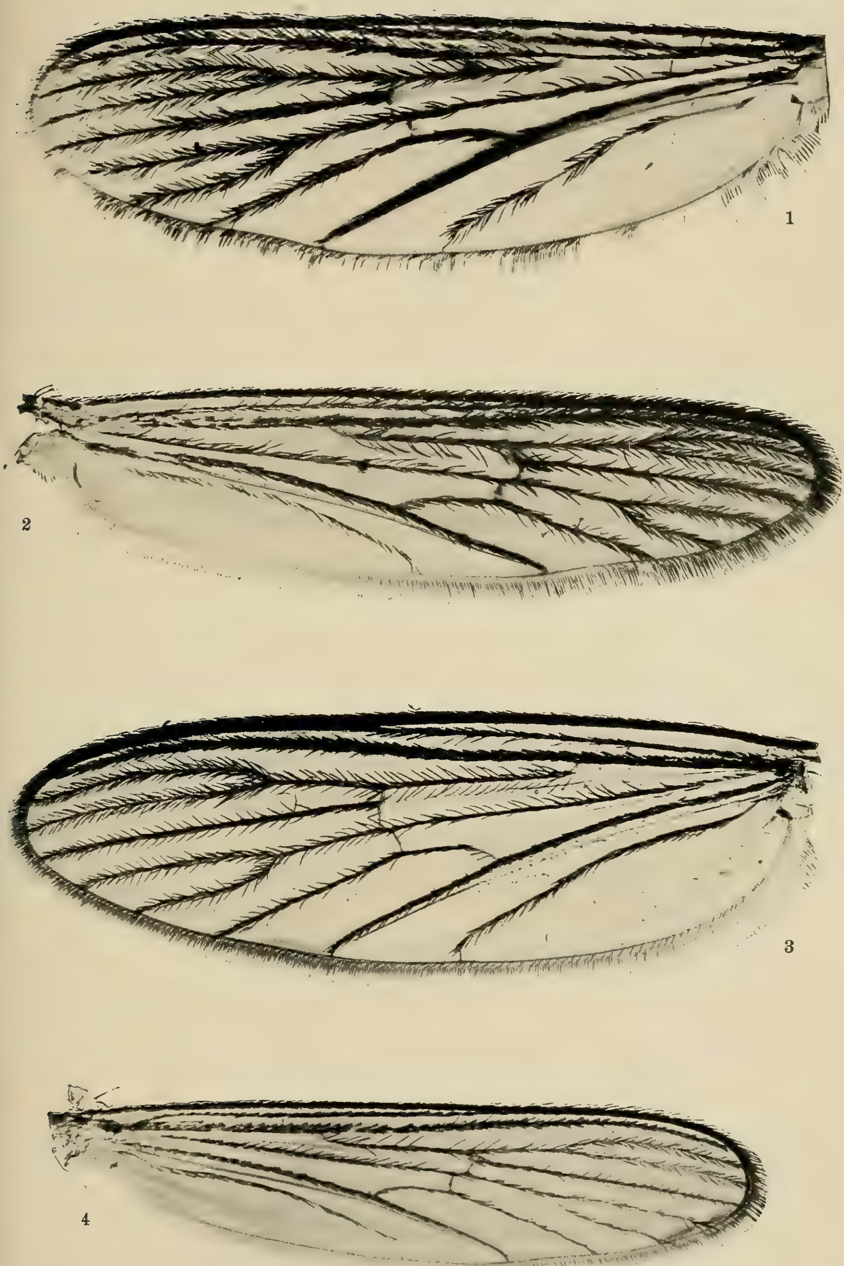
3



4

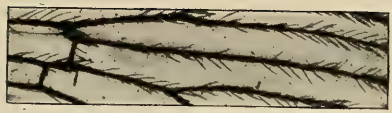
1, 2 Culex cinereoborealis. 3,4 C. impiger

Plate 8

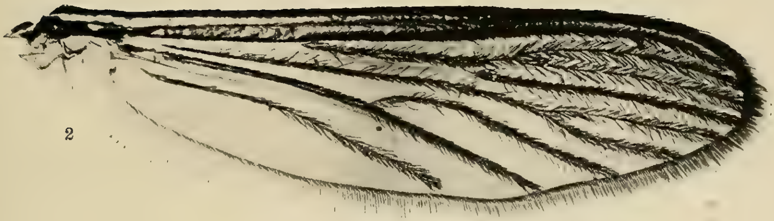


1,2 Culex absobrinus. 3,4 C. magnipennis

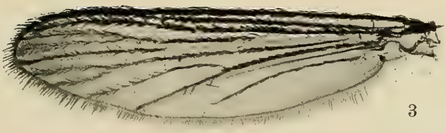
Plate 9



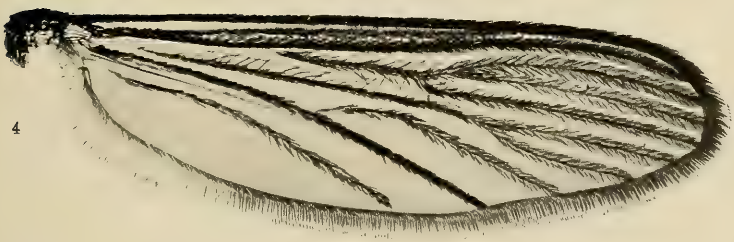
1



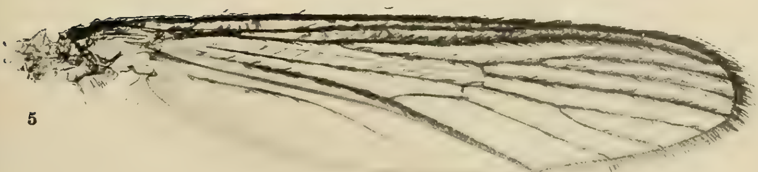
2



3



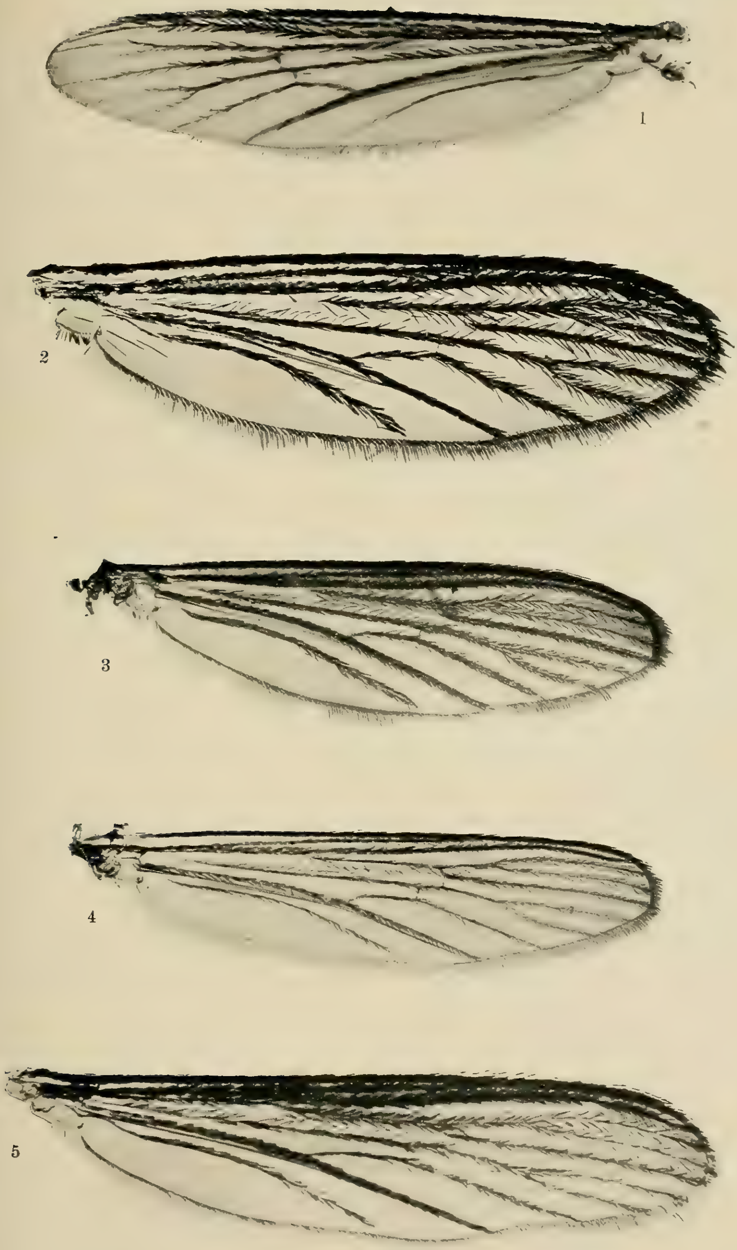
4



5

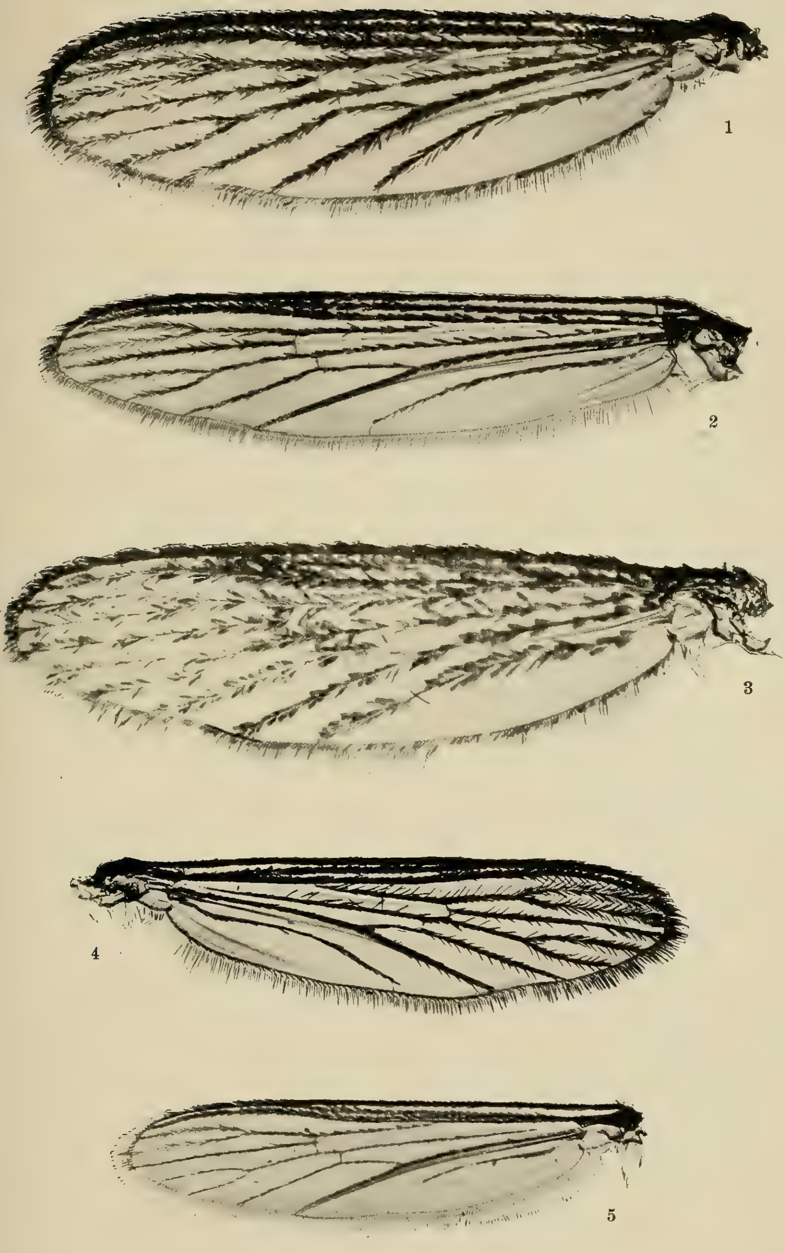
1 Culex consobrinus. 2,3 C. restuans. 4,5 C. pipiens

Plate 10



1 Culex dyari. 2 C. abserratus 3, 4 C. salinarius
5 C. triseriatus

Plate 11

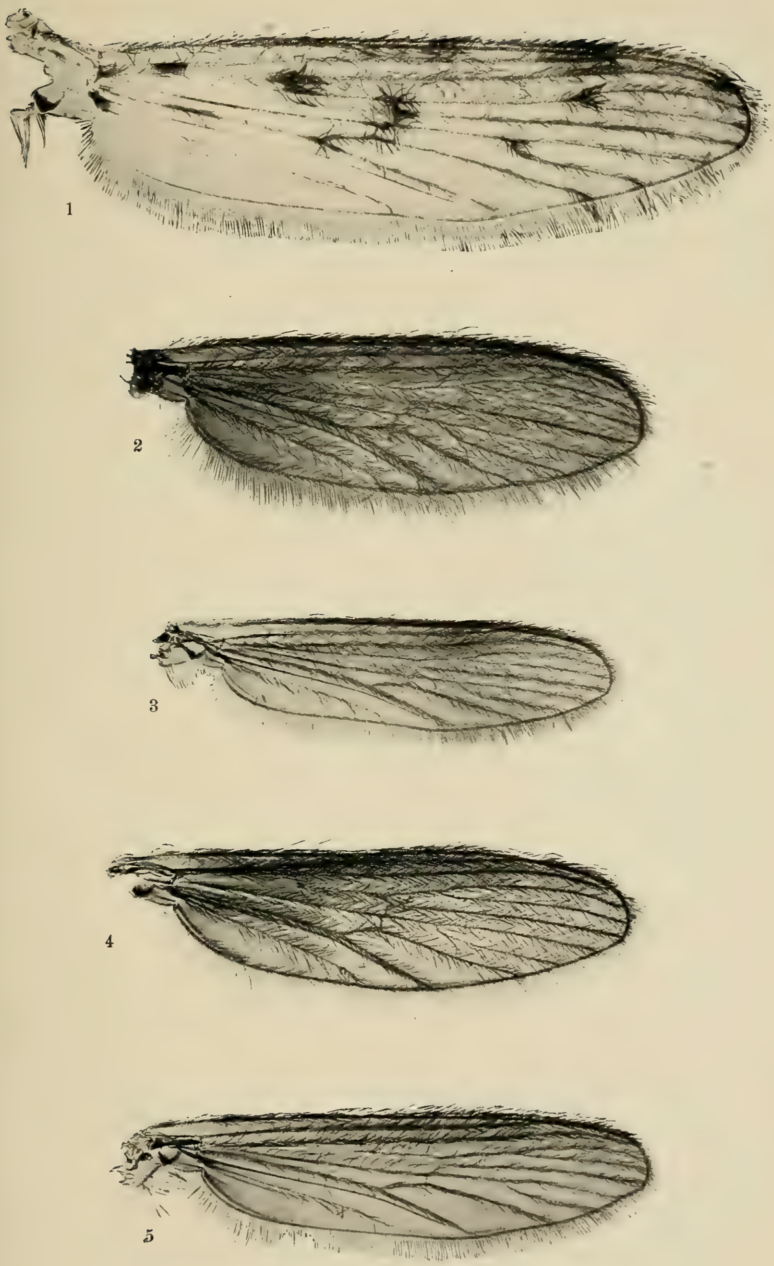


1, 2 Culex aurifer. 3 Taeniorhynchus perturbans
4, 5 Aedes fuscus

Plate 12

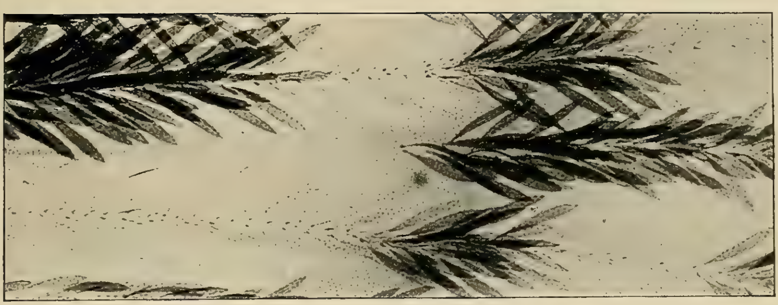
1 Uranotaenia sapphirina. 2,3 Eucorethra underwoodi. 4 Sayomyia trivittata

Plate 13



1 Sayomyia trivittata. 2, 3 S. rotundifolia
4, 5 S. hudsoni

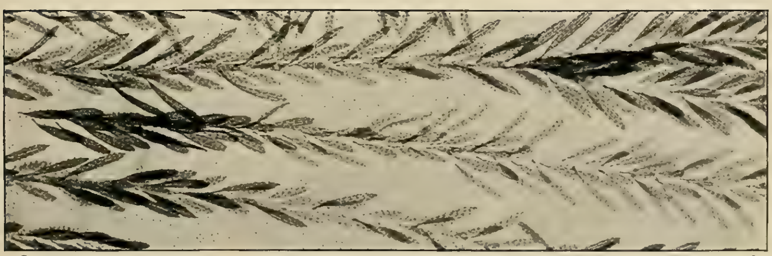
Plate 14



1

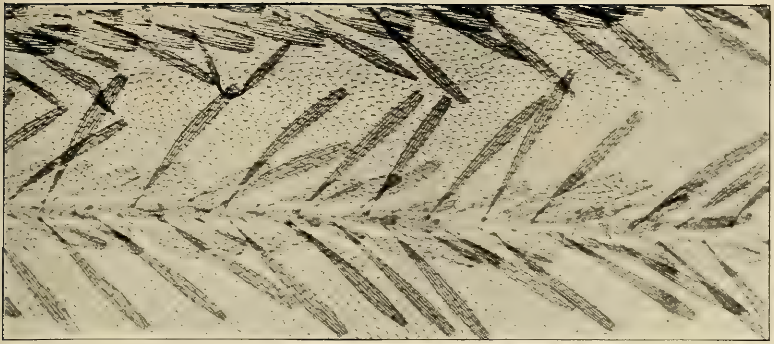
2

3

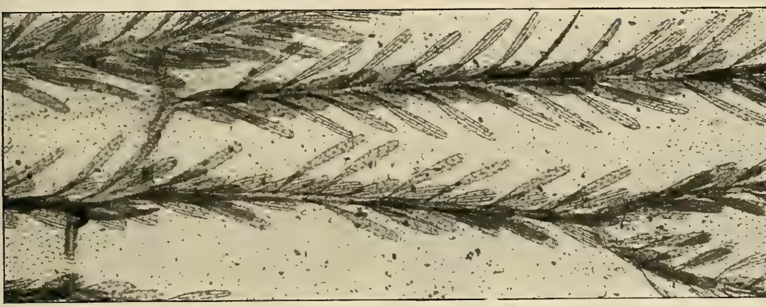


4

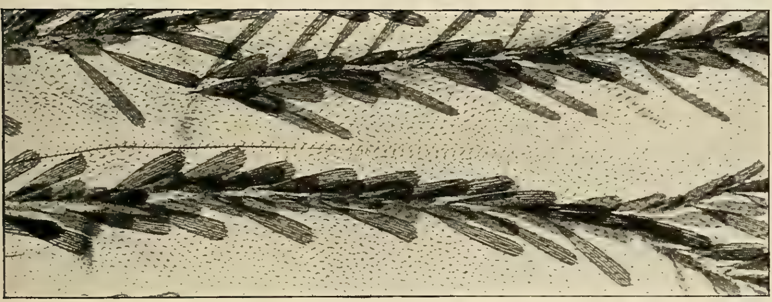
1,2 Anopheles punctipennis. 3,4 A. maculipennis



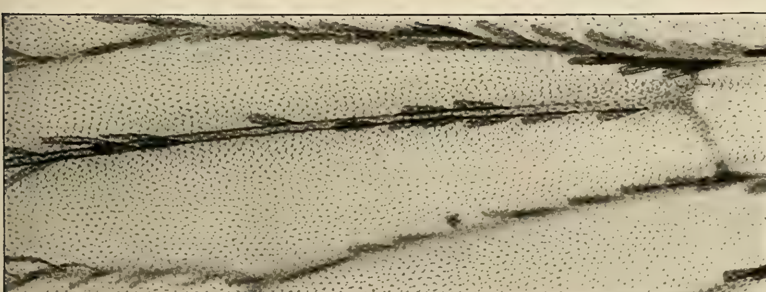
1



2

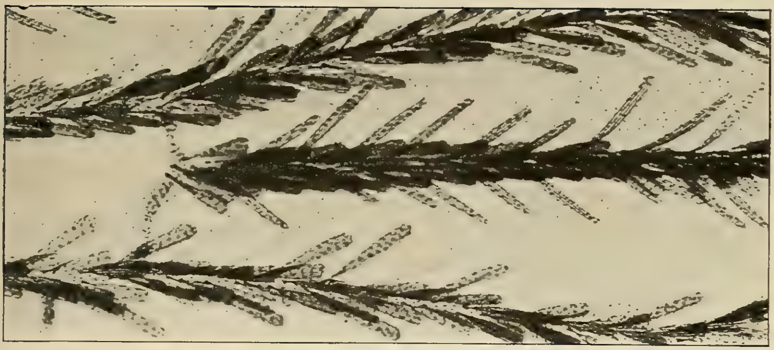


3

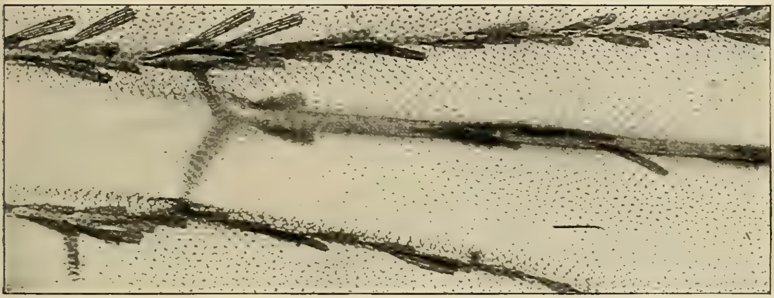


4

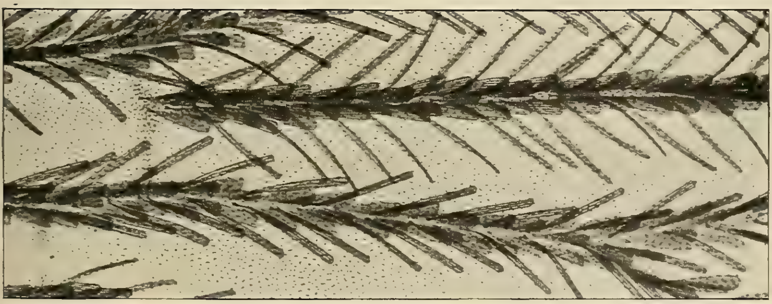
1 Psorophora ciliata. 2 Janthinosoma musica
3, 4 Culex fitchii



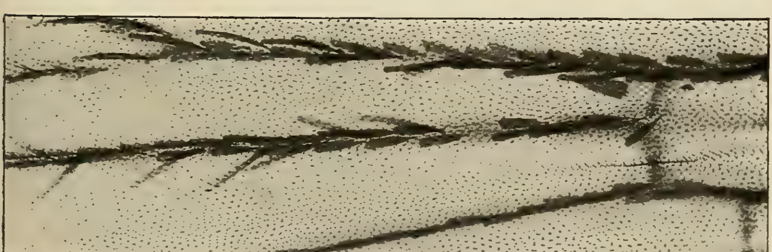
1



2

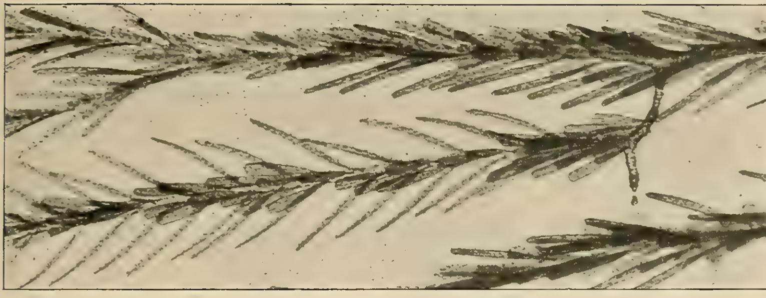


3

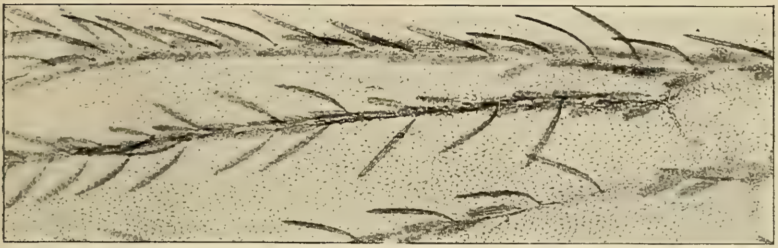


4

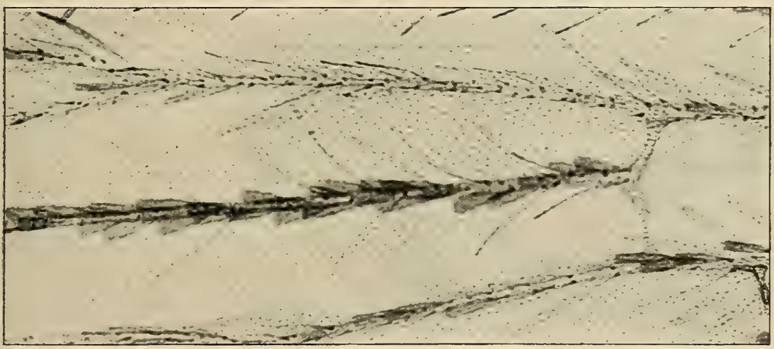
1, 2 Culex cantans. 3, 4 C. sylvestris



1



2

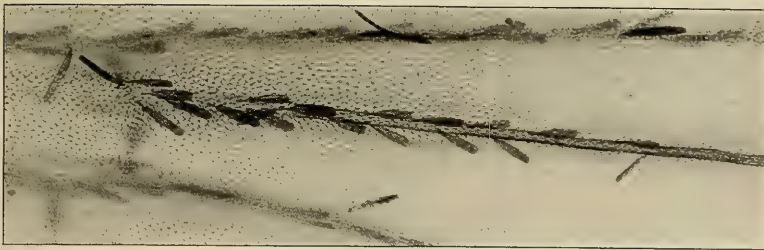


3

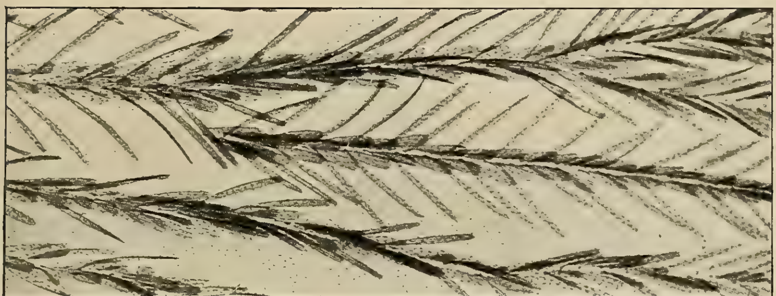
4

1, 2 C. cantator. 3 C. onondagensis. 4 C. sollicitans

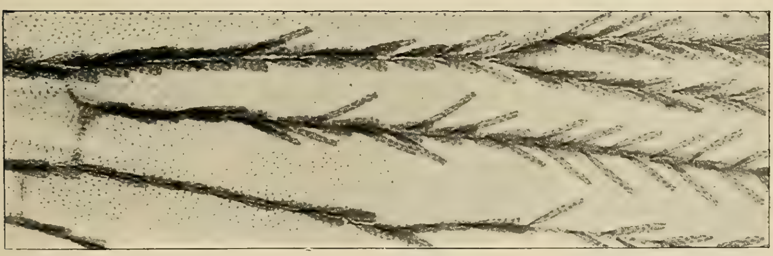
Plate 18



1



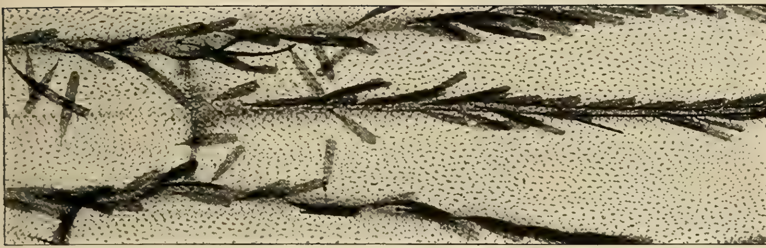
2



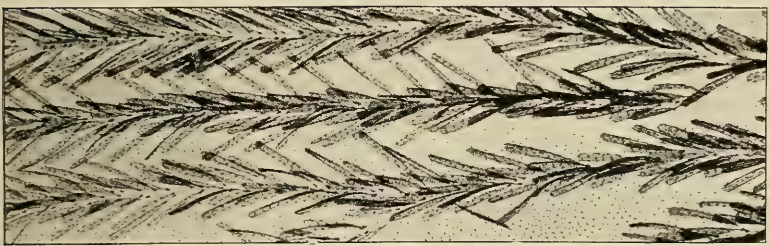
3

4

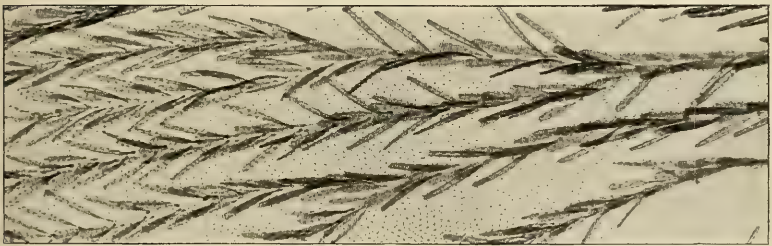
1 Culex sollicitans. 2,3 C. taeniorhynchus.
4 C. canadensis



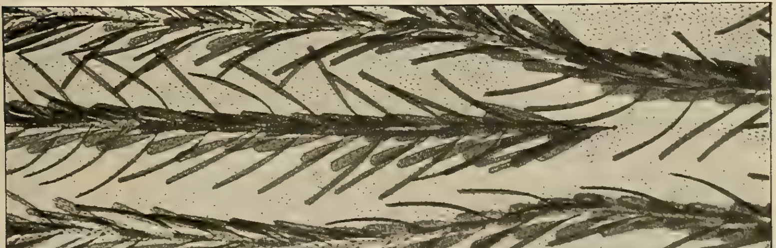
1



2



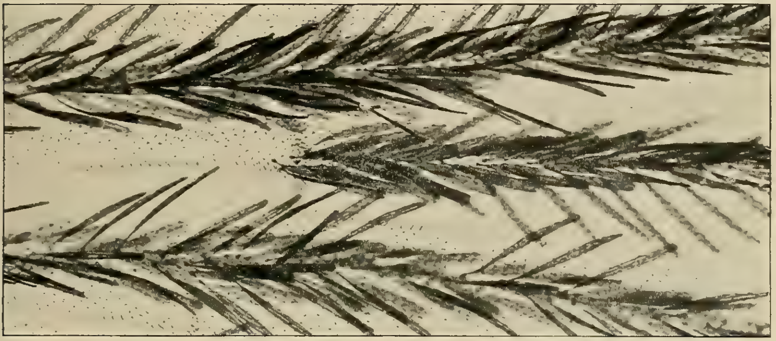
3



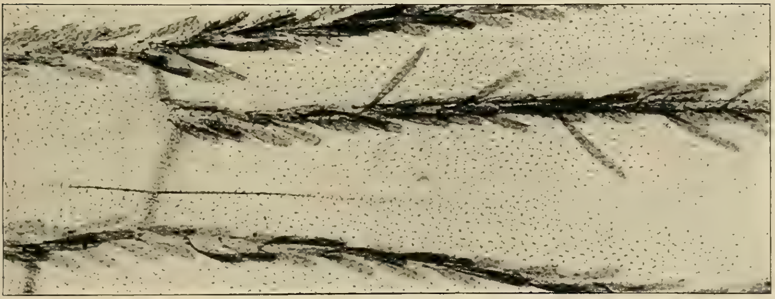
4

1 Culex canadensis. 2, 3 C. atropalpus. 4 C. territans

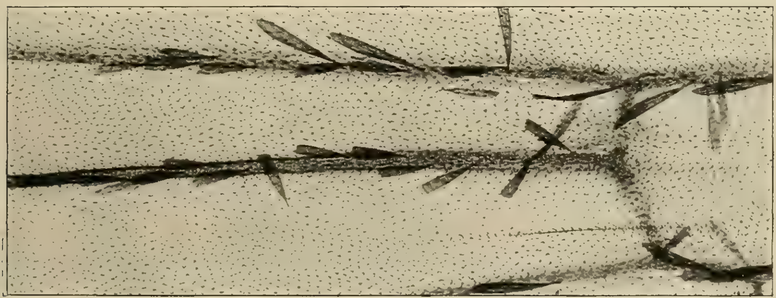
1



2

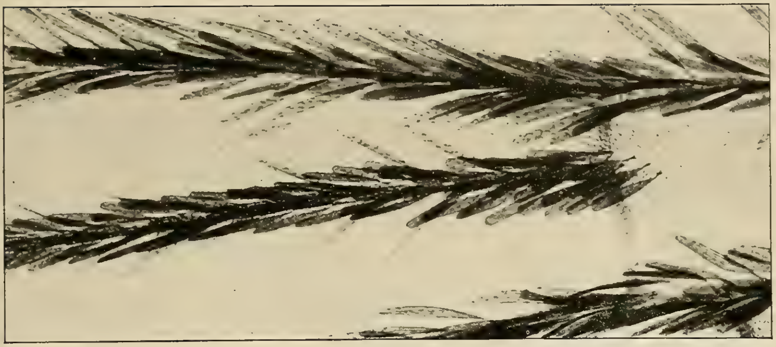


3

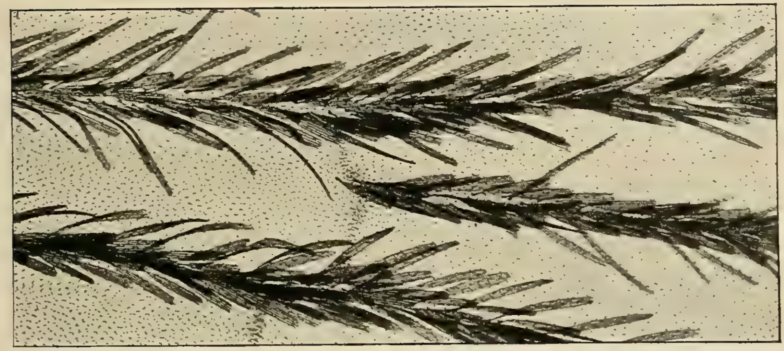


4

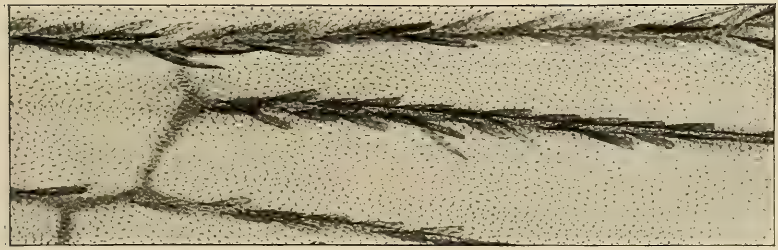
1 Culex territans. 2.3 C. lazarensis.
4 C. cinereoborealis



1



2

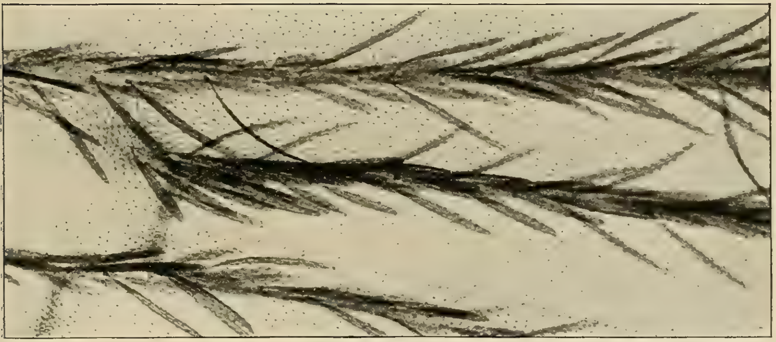


3

4

1 Culex cinereoborealis. 2,3 C. impiger. 4 C. dyari

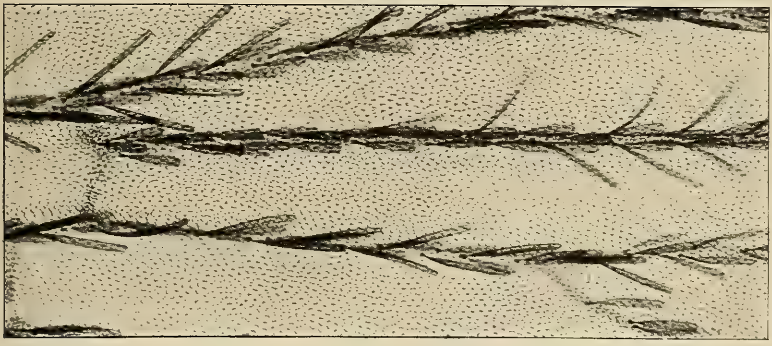
1



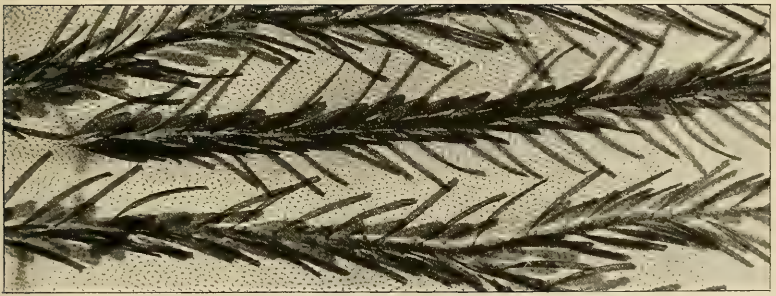
2

3

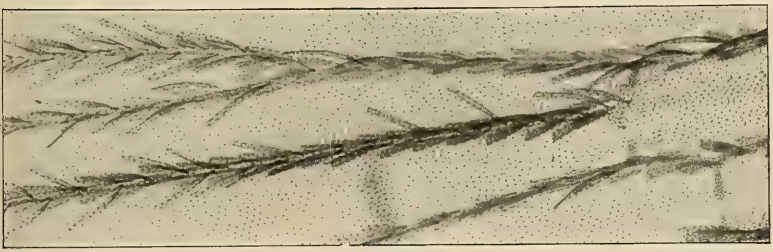
1, 2 C. absobrinus. 3 C. magnipennis



1



2

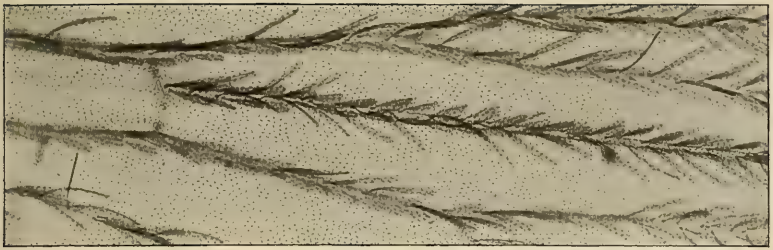


3

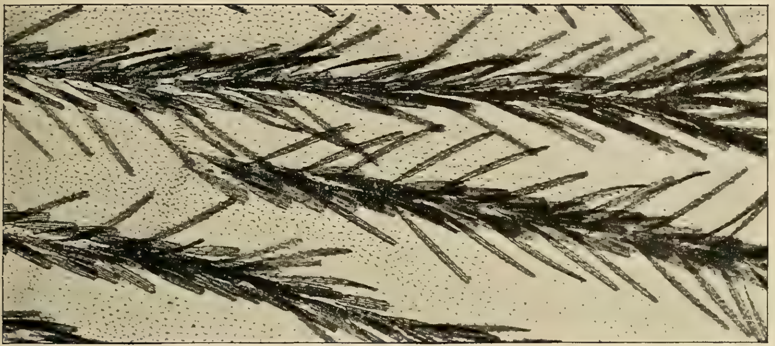
4

1 Culex magnipennis. 2,3 C. restuans. 4 C. pipiens

Plate 24

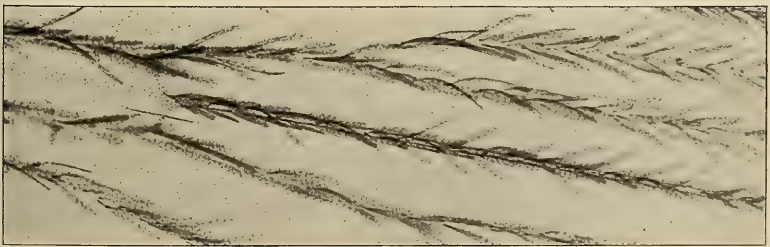


1



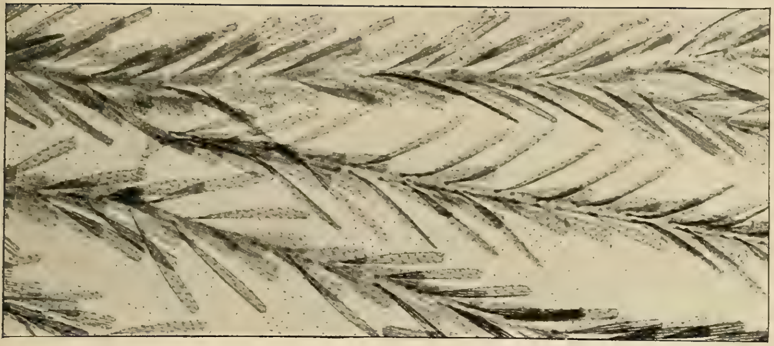
2

3

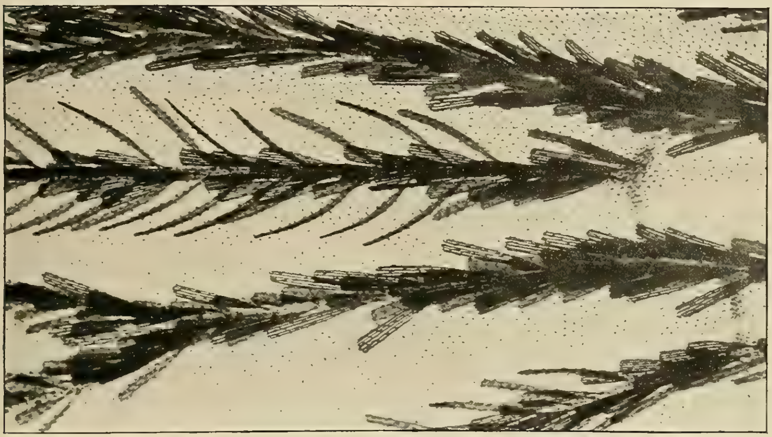


4

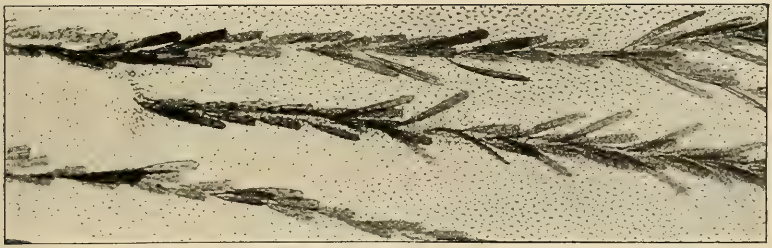
1 Culex pipiens. 2 C. abserratus. 3,4 C. salinarius



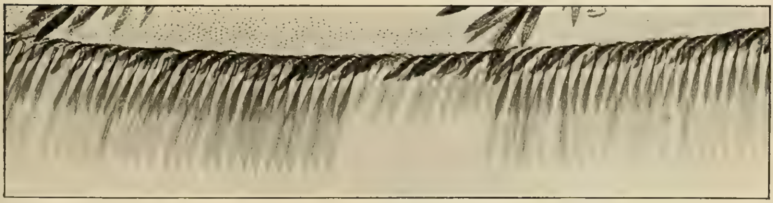
1



2

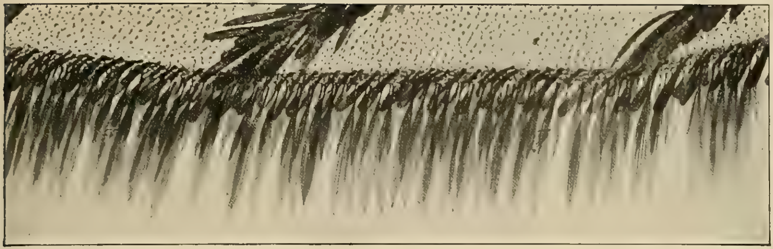


3

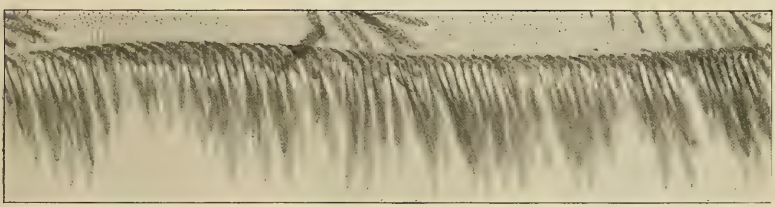


4

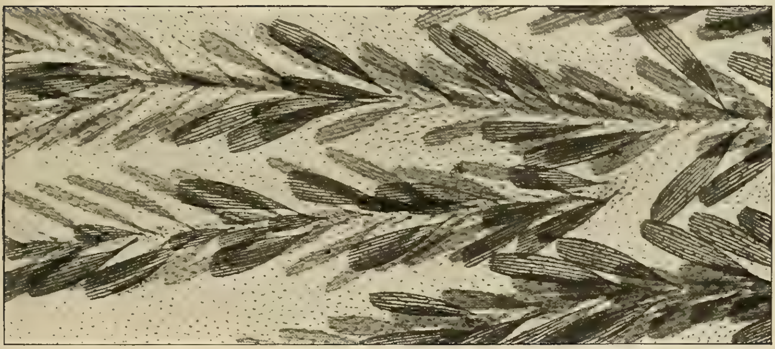
1 Culex triseriatus. 2,3 C. aurifer. 4 Anopheles maculipennis



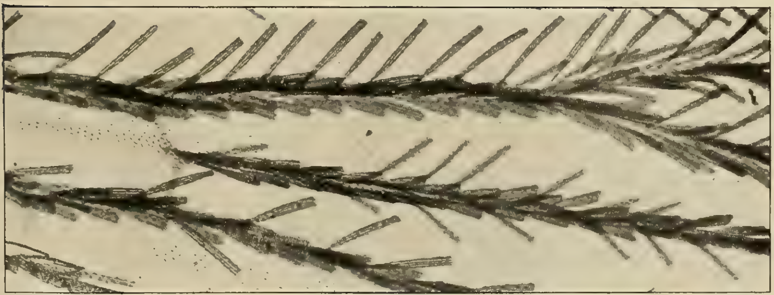
1



2

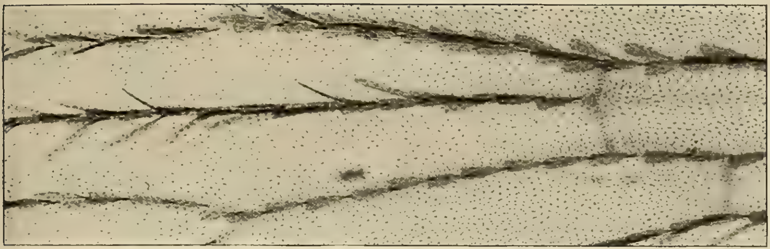


3

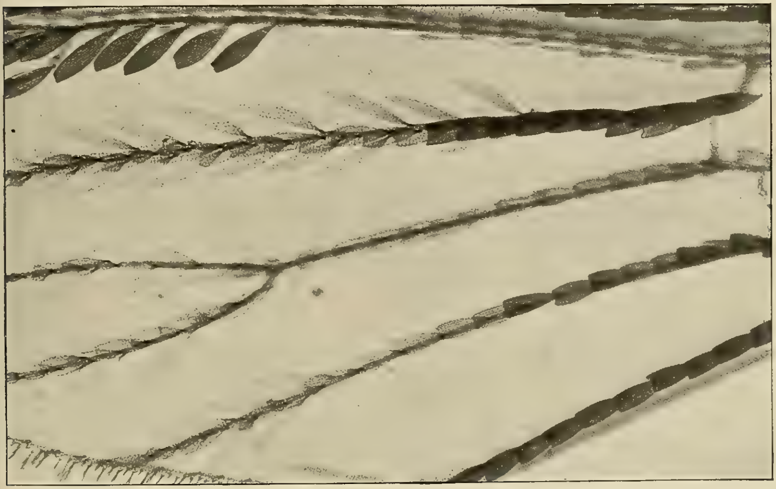


4

1 Culex cinereoborealis. 2 C. pipiens. 3 Taeniorhynchus perturbans. 4 Aedes fuscus

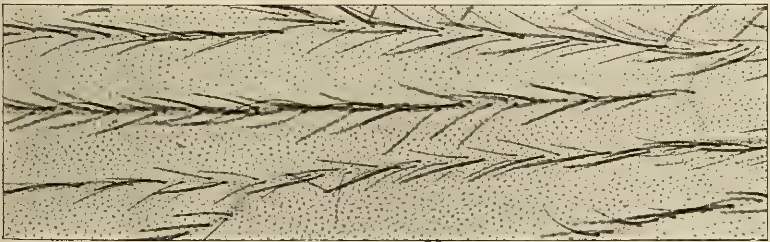


1



2

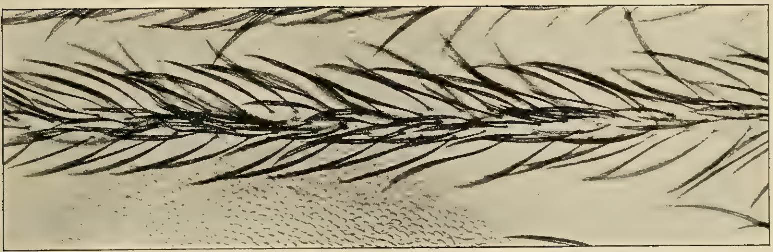
3



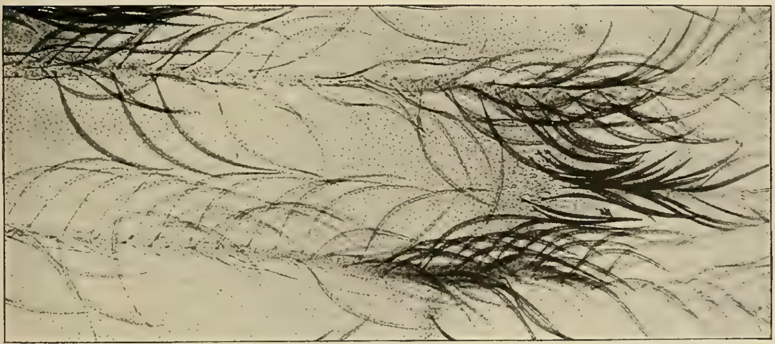
4

1 Aedes fuscus. 2,3 Uranotaenia sapphirina.
4 Corethra lintneri

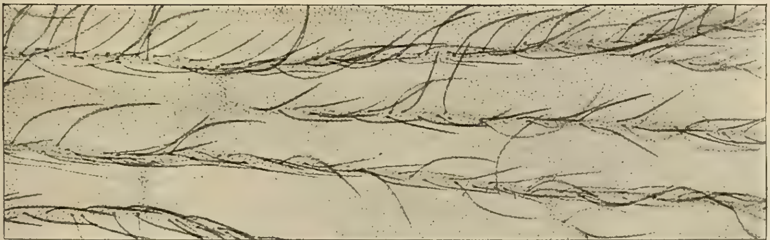
1



2

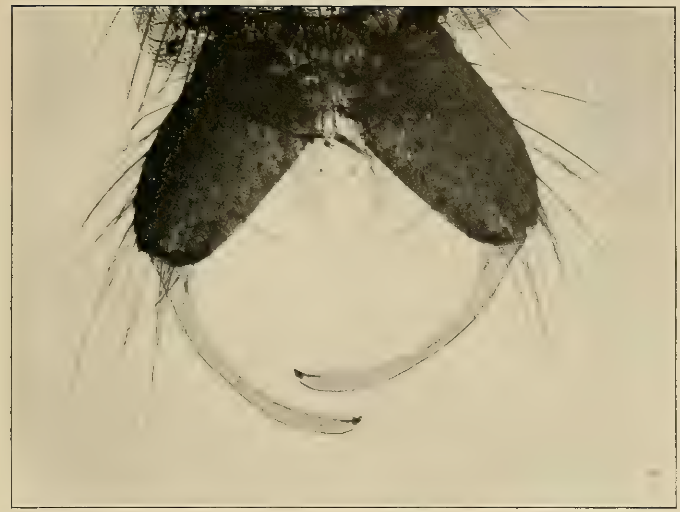


3



4

1 Corethra cinctipes. 2 Eucorethra underwoodi.
3 Sayomyia trivittata. 4 S. hudsoni

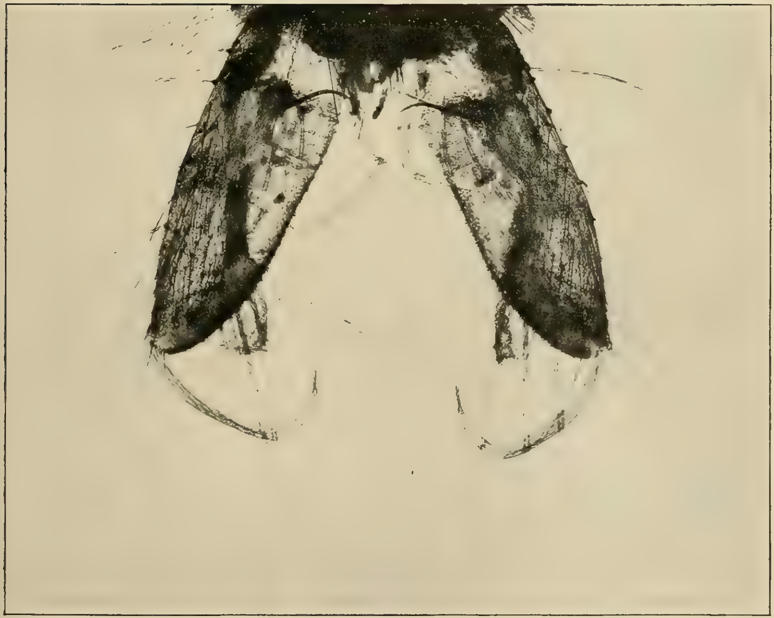


1

2

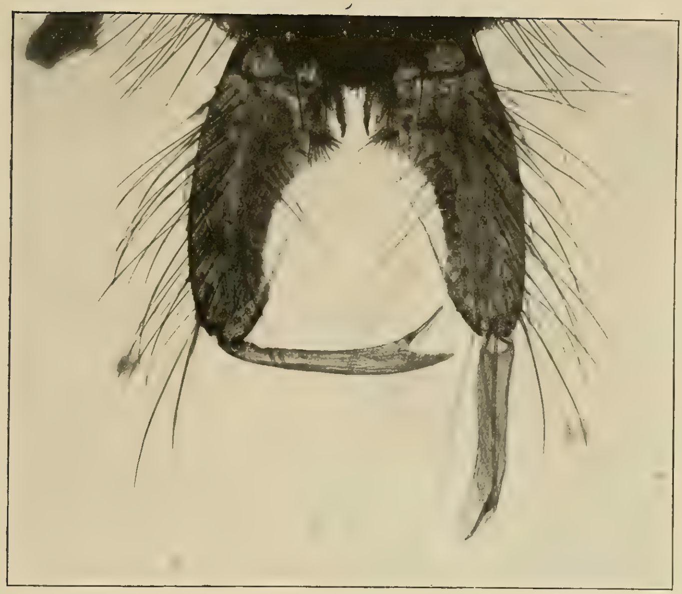
1 Anopheles punctipennis. 2 A. maculipennis

1



2

1 Psorophora ciliata. 2 Culex cantans



1

2

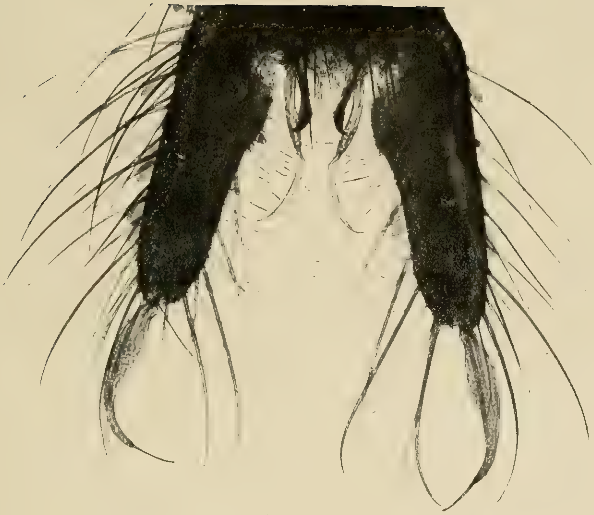
1 Culex sylvestris. 2 C. cantator

1

2

1 Culex sollicitans. 2 C. atropalpus

Plate 33



1

2

1 Culex taeniorhynchus. 2 C. aurifer

1

2

3

1,2 Culex territans. 3 C. canadensis

1

2

1 Culex dyari. 2 C. lazarensis

1

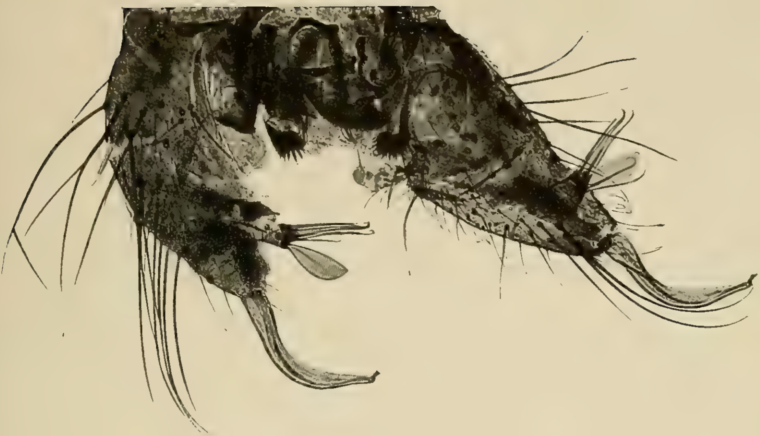
2

1 Culex impiger. 2 C. cinereoborealis

1

2

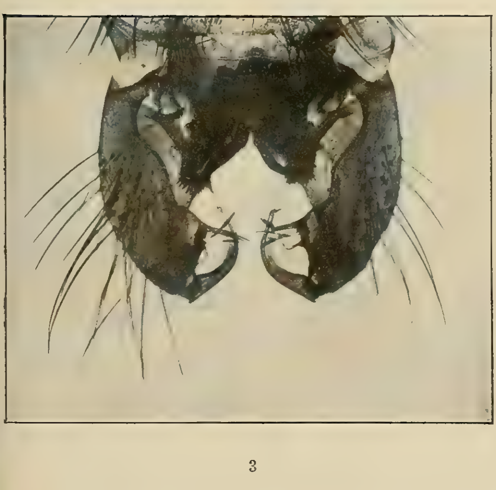
1 Culex absobrinus. 2 C. magnipennis



1

2

5

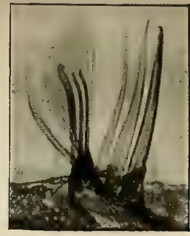


3

4

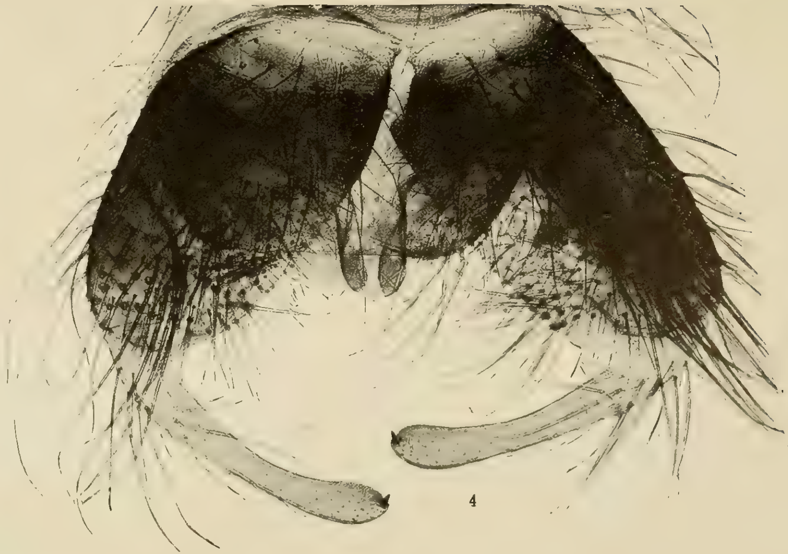
1, 2 Culex restuans. 3–5 C. pipiens

1



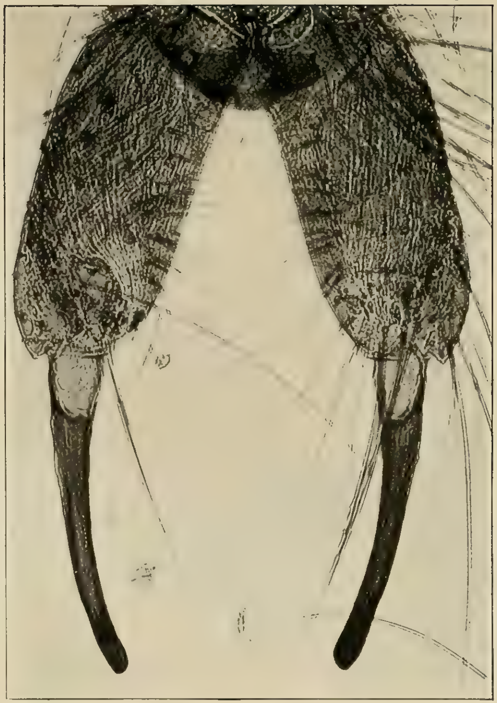
2

3



4

1,2 Culex salinarius. 3 Aedes fuscus. 4 Eucorethra underwoodi



1

2

1 Sayomyia hudsoni. 2 S. rotundifolia

2

3

1

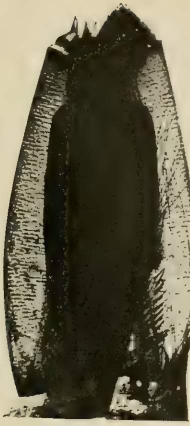
4

1 Psorophora ciliata. 2 Culex fitchii. 3 C. abfitchii
4 C. cantans

Plate 42

1

2



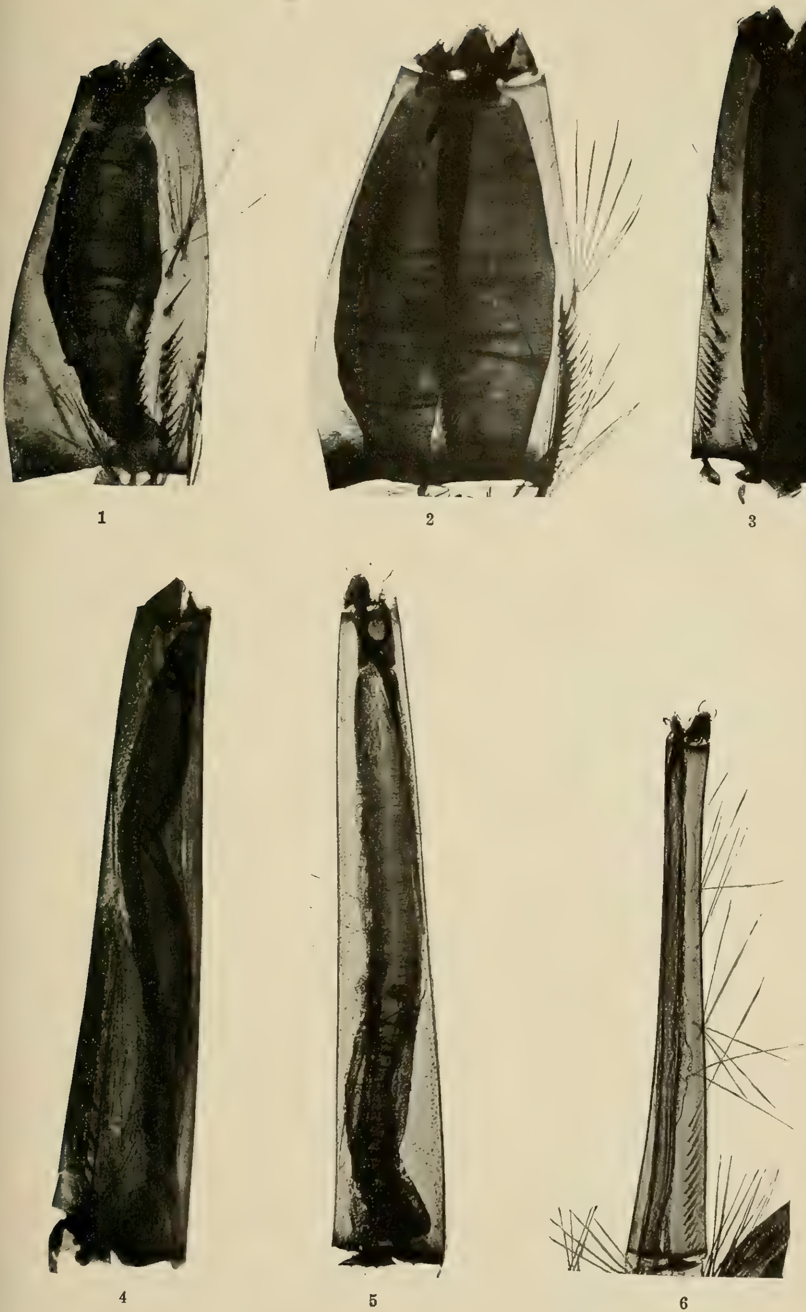
3

4

5

1 Culex taeniorhynchus. 2 C. sollicitans. 3 C. cantator. 4 C. canadensis. 5 C. sylvestris

Plate 43



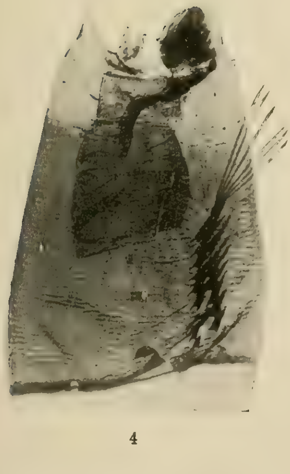
1 Culex impiger. 2 C. lazarensis. 3 Aedes fuscus
4 C. dyari. 5 C. salinarius. 6 C. territans

Plate 44

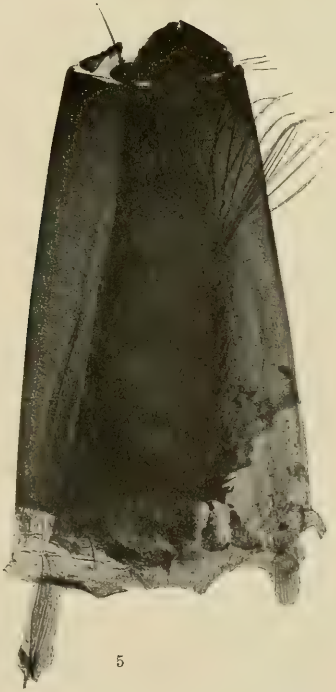
1

2

3

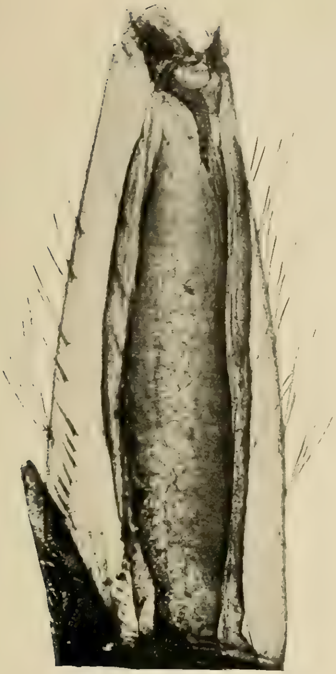


4



5

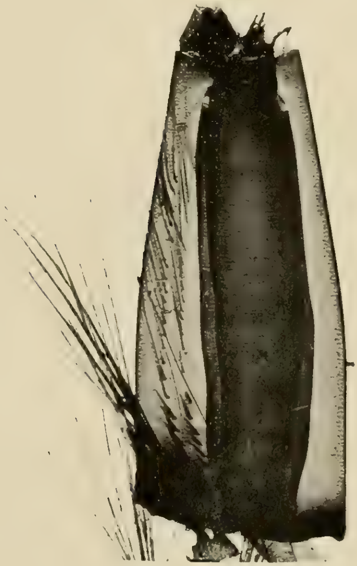
1 Culex pipiens. 2 C. jamaicensis. 3 C. restuans
4 C. serratus. 5 C. atropalpus



1

2

3



4

1 Culex cinereoborealis. 2 C. abserratus. 3 C. magnipennis. 4 C. absobrinus

Plate 46

1

2

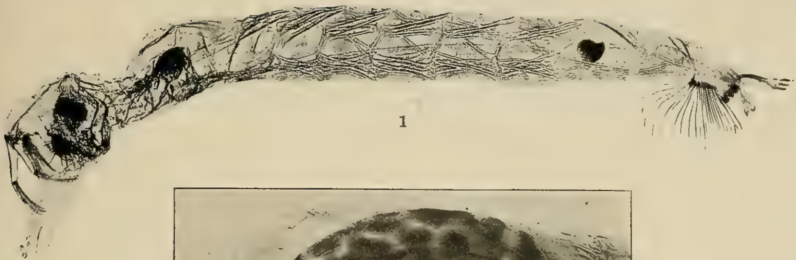
3

4

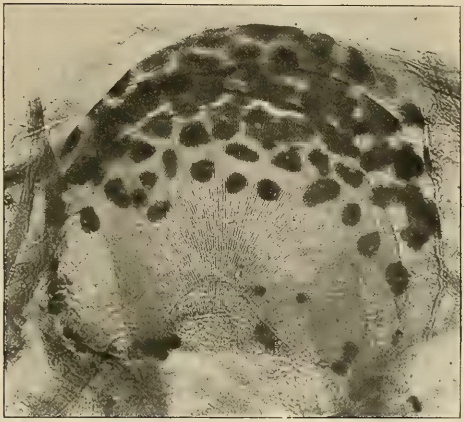
5

6

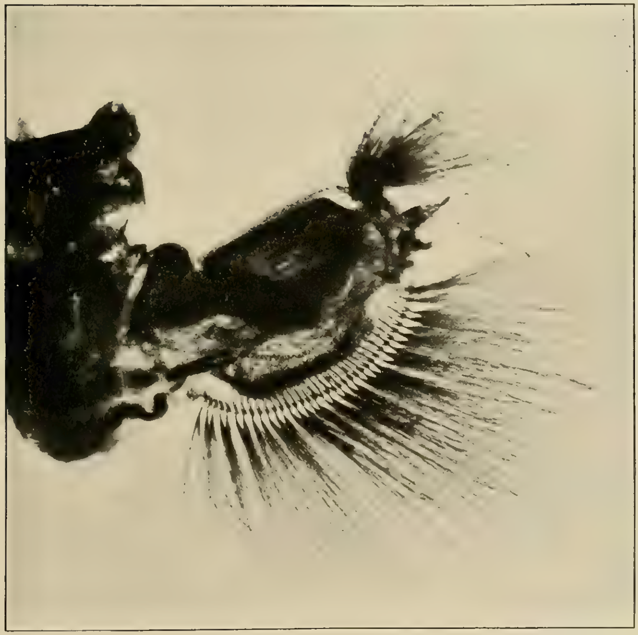
1 Culex melanurus. 2 Uranotaenia sapphirina. 3 C. dupreei. 4 C. discolor. 5 C. aurifer. 6 C. triseriatus



1



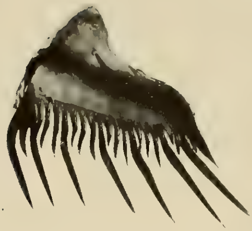
2



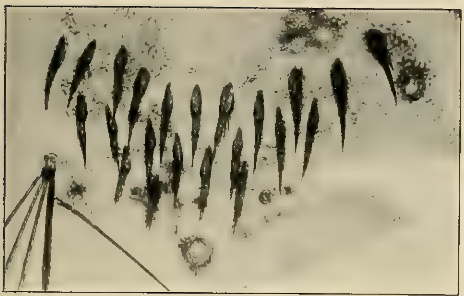
3

1 Sayomyia hudsoni. 2 S. albipes. 3 Eucorethra underwoodi

1



2



3

5

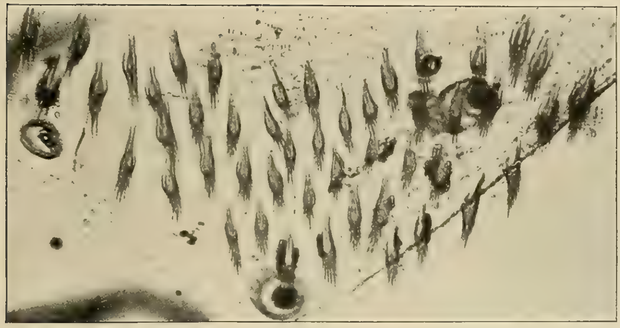
6

4

7

1 Anopheles punctipennis. 2 A. maculipennis. 3 Culex fitchii. 4 C. abfitchii. 5 C. discolor. 6 C. melanurus. 7 Uranotaenia sapphirina

1



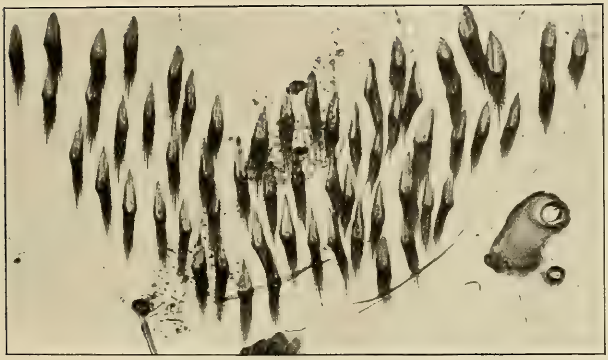
2

3

1 Culex sylvestris. 2 C. cantator. 3 C. ? cantans

Plate 50

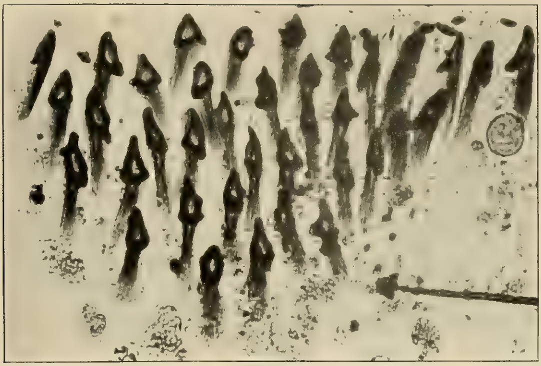
1



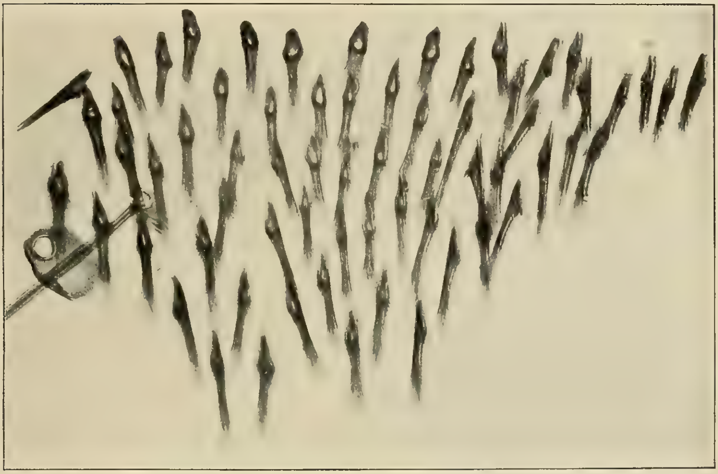
2

3

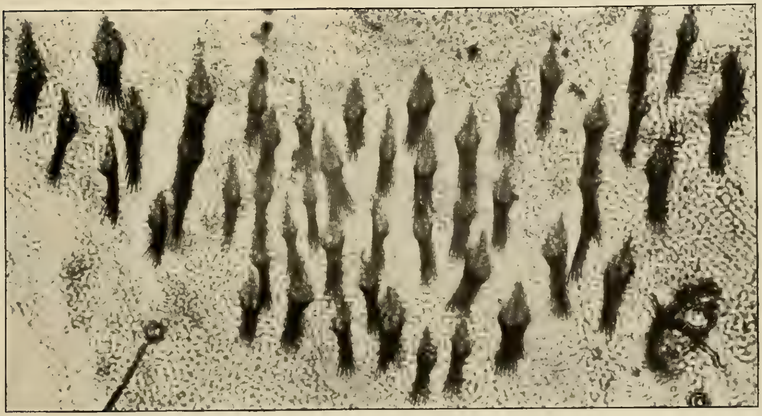
1 Culex cantans. 2 C. canadensis. 3 C. sollicitans



1

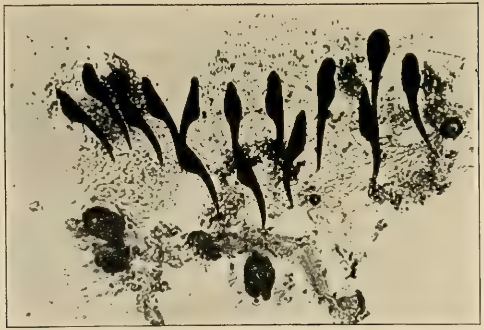


2

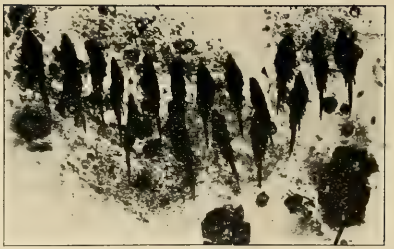


3

1 Culex magnipennis. 2 C. absobrinus. 3 C. lazarensis

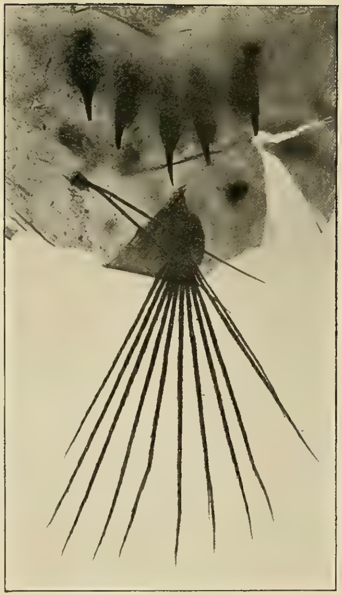


1



2

3



4

5

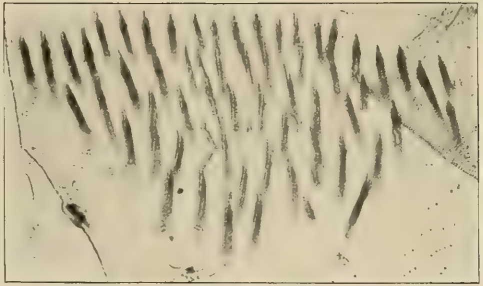
1 Culex impiger. 2 C. aurifer. 3 Aedes fuscus. 4 C. serratus. 5 C. cinereoborealis

Plate 53

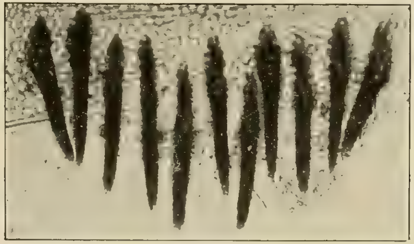
1

2

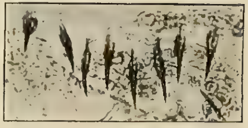
3



4

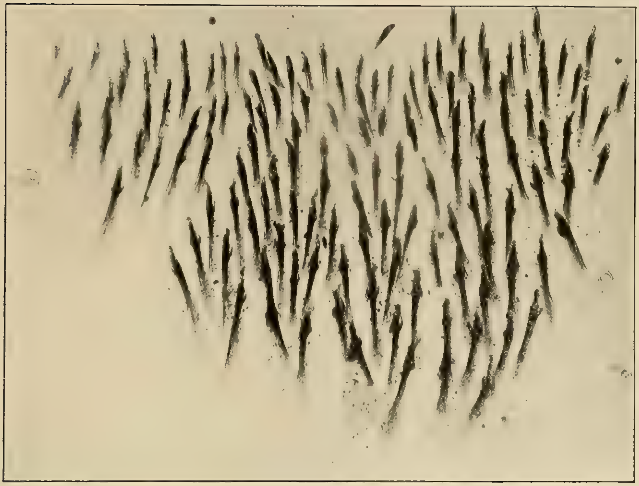


5

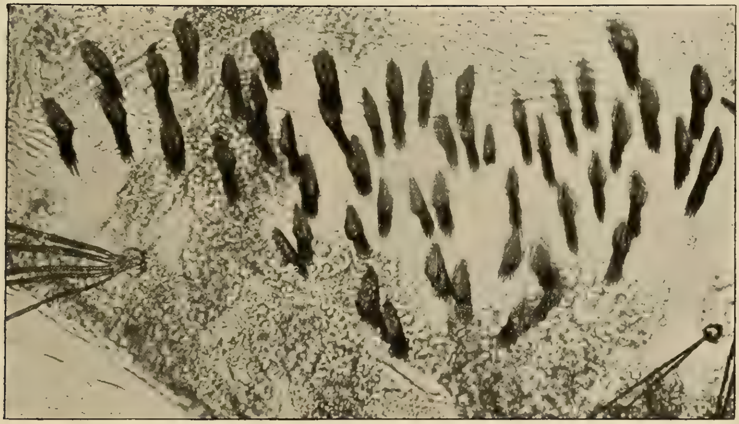


6

1 Culex taeniorhynchus. 2 C. restuans. 3 C. pipiens. 4 C. salinarius. 5 C. triseriatus
6 C. dupreei

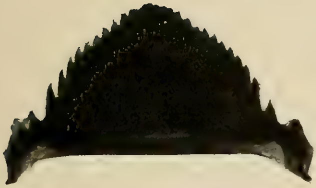


1

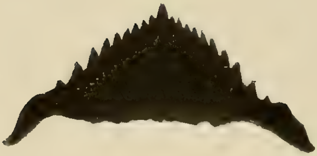


2

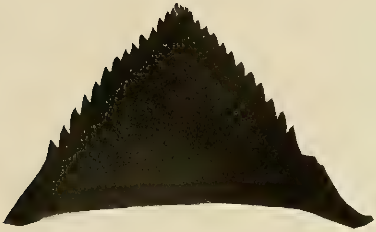
1 Culex dyari. 2 C. atropalpus



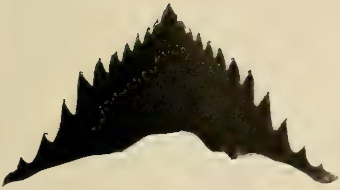
2



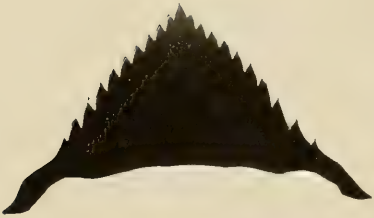
3



1



4



5

1 Culex cinereoborealis. 2 C. magnipennis
3 C. atropalpus. 4 C. dyari. 5 C. aurifer

Plate 56

1

2

1 Janthinosoma musica. 2 Culex jamaicensis

1

2

1 Culex melanurus. 2 C. triseriatus

APPENDIX

GENERIC REVISION OF CULICIDAE

Our knowledge of Culicidae has progressed so rapidly that our American species are sadly confused, and this opportunity is taken of presenting briefly the results of our taxonomic studies.

ANOPHELINAE

Anopheles. Palpi long in both sexes. Wings usually spotted and thickly clothed with lanceolate scales. First and second longitudinal veins extending beyond the cross veins into the basal cells. Apical clasp segment of male genitalia evenly curved and with an inconspicuous terminal spine. Harpes and harpagones small. Larva with very short air tube and consolidated comb. Species, punctipennis Say, maculipennis Meig. and crucians Wied.

CULICINAE

Psorophora. Petioles of female wing about two thirds the length of fork cells. Posterior cross vein less than its own length from mid cross vein. Lateral scales remarkably distinct; vein scales long, rather broad. Male wing sparsely clothed with scales; petioles about equal in length to their respective fork cells, posterior cross vein less than its own length from mid cross vein. Terminal clasp segment of male genitalia strongly curved and armed with stout spines, basal portion stout. Harpes strongly curved with subapical, falcate organ and terminated by a tuft of loose filaments. Harpagones stout, with several apical teeth. Larva with few comb scales arranged in a semicircle; anteriorly, many minute, smaller, comblike organs, larger comb scales with spatulate base, a large median tooth and conspicuous lateral ones. Species, ciliata Abr.

Janthinosoma. *Female.* Petioles of fork cells about one half the length of their respective cells. Posterior cross vein less than its own length from mid cross vein. Lateral scales of wing broad, well separated from the broadly triangular, closely appressed vein scales. *Male.* Petioles about equal to their respective fork cells. Posterior cross vein about its own length from mid cross vein. Lateral scales broad, well separated from the rather broad, closely appressed vein scales. Terminal clasp

segment of male genitalia greatly dilated. Harpes enormously prolonged, tipped with peculiar disklike organs; harpagones rather prominent. Larvae with comb scales few, spatulate, each with a large central tooth and prominent lateral ones. Species, musica Say.

Grabhamia. *Male.* Petioles of fork cells about equal in length to their respective cells. Posterior cross vein remote from mid cross vein. Vein scales rather short, broad. Apical clasp segment of male genitalia broadly dilated; claspette represented by a prominent spined basal lobe and a membranous apical one. Harpes short, curved; harpagones inconspicuous. Larval comb scales few, spatulate, each with a large central tooth and prominent lateral ones. Type, jamaicensis Theo., species, discolor Coq.

Culicelsa n. gen. Petiole of anterior fork cell of female wing about one half its length. Posterior cross vein more than its own length from mid cross vein. Linear scales well separated from the subtriangular, appressed vein scales. Petiole of fork cell in male about two thirds its length. Terminal clasp segment of male genitalia swollen at base. Harpes with a peculiar retrorse spine. Larva with short air tube, the comb composed of numerous, spatulate, spined scales. Type, taeniorhynchus Wied., species, aurifer Coq.

Culicada n. gen. Petiole of first fork cell of female wing nearly equal in length to that of the cell. Posterior cross vein about its own length from mid cross vein. Long scales distinct or shading with the closely appressed, usually thick vein scales. Petiole of first fork cell in male equal in length to that of the cell, posterior cross vein about its own length from mid cross vein. Terminal clasp segment of male genitalia well developed with long apical spine. Claspette usually represented by well defined, apical and basal lobes. Harpes well developed, usually long and varying in shape. Larva with good sized air tube and variable comb scales. Type, canadensis Theo., species, cantans Meig., cantator Coq., sollicitans Walk., onondagensis Felt, atropalpus Coq., triseriatus Say, and probably trivittatus Coq. Also, though possibly constituting a subgenus: cinereoborealis Felt & Young, impiger Walk., lazarensis Felt & Young, pullatus Coq.,

abserratus Felt & Young, dupreei Coq., and probably squamiger Coq., fitchii Felt & Young and abfitchii Felt.

Ecculex n. gen. Petiole of anterior fork cell of female wing about one half its length. Posterior cross vein more than its length from mid cross vein. Lateral scales long, well separated from the closely appressed, broad vein scales. Terminal clasp segment of male genitalia with subapical spine. Claspette a rather conspicuous basal lobe. Harpes broad, with recurved, terminal spine; harpagones terminated by three long, recurved spines. Larva with well developed air tube, comb scales with spatulate base and stout, terminal spine. Type, sylvestris Theo., species, melanurus Coq.

Culicella n. gen. Petiole of anterior fork cell of female wing about two thirds its length. Posterior cross vein about its own length from mid cross vein. Lateral vein scales well defined. Petiole of anterior fork cell in male equal or longer than its cell, posterior cross vein less than its own length from mid cross vein. Terminal clasp segment of male genitalia slender, slightly curved, with small apical spine. Claspette a large basal lobe with prominent chitinous spine. Larva with very long air tube and with a large comb consisting of linear, ciliated scales. Type, dyari Coq.

Culiseta n. gen. Petiole of anterior fork cell of female wing about one half its length. Posterior cross vein less than its own length from mid cross vein. Scales very large, lateral ones slender, linear; vein scales closely appressed, frequently elongated. Male wing with petiole of first fork cell one half to two thirds the length of the cell and the posterior cross vein about its own length from mid cross vein. Basal clasp segment of male genitalia triangular, apical segment slender, nearly straight. Claspette represented by a conspicuous basal lobe with one or more large, chitinous spines. Harpagones recurved, with several apical teeth. Larvae with pecten prolonged into setae and with stout, spined comb scales. Type, absobrinus Felt, species, magnipennis Felt and probably incidens Thom.

Taeniorhynchus. Petiole of first fork cell of female wing about two thirds the length of the cell. Posterior cross vein several times its length from mid cross vein. Wings thickly clothed with

conspicuous dilated scales. Terminal clasp segment of male genitalia slightly swollen. Claspette a conspicuous basal lobe bearing a stout, apical spine. Harpes strongly curved and bearing a series of stout teeth. Species, perturbans Walk.

Stegomyia. We have had no opportunity of studying either larvae or adults of S. signifer Coq., the only species liable to occur in New York State. Judging from descriptions and a print of the male genitalia kindly sent us by Dr Dyar, it probably belongs close to Taeniorhynchus.

Culex. Petioles of fork cells of female wing short, that of the anterior one seventh to about one fifth the length of its cell. Posterior cross vein more than its own length from mid cross vein, lateral scales linear, well defined; vein scales broadly rounded, closely appressed. Petiole of anterior fork cell in male about one third its length. Lateral scales well marked but more sparse than in the other sex. Claspette represented by a prominent tuft of chitinous spines and frequently by a dilated, spatulate organ at the apical third and a rather inconspicuous prominence near the base of the clasp. Larvae with very long air tube bearing inconspicuous basal pecten, and with comb composed of about 50 minute, ciliated scales. Type, pipiens Linn., species, salinarius Coq., restuans Theo. and territans Walk.

Protoculex n. gen. Petiole of anterior fork cell of female wing about one half the length of the cell. Posterior cross vein more than its own length from mid cross vein. The long lateral scales well separated from the appressed vein scales. Petiole of anterior fork cell of the male about equal in length to that of the cell. Terminal clasp segment of male genitalia slender, curved, with stout apical spine. Claspette represented by a conspicuous basal spine-bearing lobe and a longer terminal one. Harpes broadly dilated at base, slender apically; harpagones with recurved apical spine. Larva with medium air tube, comb consisting of a few spinelike scales. Type, serratus Theo.

AEDEOMYINAE

Uranotaenia. Petiole of anterior fork cell of female wing exceedingly long. Posterior cross vein scarcely its length from mid cross vein. Wings remarkable on account of the varied character of the scales. Terminal clasp segment of male genitalia straight,

tapering to an obscure point, basal portion stout. Larva with a small, slightly curved, subcylindric air tube, and comb consisting of a few simple spines attached to the posterior margin of a chitinous plate. Species, s a p p h i r i n a O. S.

Aedes. Petiole of first fork cell of female wing about two thirds the length of the cell. Posterior cross vein several times its length from mid cross vein. Lateral scales very distinct from the closely appressed, rather broad vein scales. Male wing nearly the same except for its scantier clothing. Terminal clasp segment of male genitalia subapical with a subapical spine and conspicuous basal lobe. Harpes and harpagones relatively inconspicuous. Larva with moderate sized air tube and comb composed of a few spinelike scales. Species, f u s c o u s O. S.

Wyeomyia. Petiole of first fork cell of female wing nearly one half the length of the cell. Posterior cross vein about its own length from mid cross vein. Lateral scales very distinct from the rather closely appressed broad vein scales. Terminal clasp segment of male genitalia an irregular, semitransparent, trifid, spined structure. Larva with large setae irregularly disposed on the moderate sized air tube, and the comb composed of a few spinelike scales bordered by a transparent, serrate margin. Species, s m i t h i i Coq.

CORETHRINAE

Sayomyia. Petiole of anterior fork cell of female wing about as long as the cell. Posterior cross vein about its length from mid cross vein. Veins rather thickly clothed with almost linear scales. Terminal clasp segment of male genitalia rather slender, tapering, with long apical spine. Harpes and harpagones inconspicuous. Larva predaceous, with pigmented air sacs in thoracic and eighth abdominal segments; no air tube. Species, p u n c t i p e n n i s Say, t r i v i t t a t a Loew., a l b i p e s Johns., r o t u n d i f o l i a Felt, a m e r i c a n a Johns., h u d s o n i Felt.

Eucorethra. Petiole of anterior fork cell of female wing about two thirds the length of the cell, cross veins interstitial or nearly so. Vein scales thick, almost linear. Terminal clasp segment of male genitalia stout, slighty curved, with small apical spine;

basal clasp segment stout. Harpes inconspicuous, broadly dilated. Type, underwoodi Undw.

Corethra. Petiole of anterior fork cell of female wing about one third the length of cell. Posterior cross vein its own length or more from mid cross vein. Wing scales linear. Terminal clasp segment of male genitalia long, slender, with small apical spine; basal segment simple. Harpes and harpagones retracted. Larva predaceous, with small air tube and air reservoirs in the thoracic and seventh abdominal segment. Species, karnerensis Felt, lintneri Felt, cinctipes Coq.

Corethrella. This genus is similar to Sayomyia and Corethra, but differs from both in having the antennae fully covered with hairs and the apical joint shorter than the intermediate ones. The larva is said to resemble that of Corethra much more closely than that of Sayomia. Species, brakeleyi Coq.

ERRATA

P. 339, line 16, for "Aedomyniae" read "Aedeomyinae."

INDEX

The superior figures tell the exact place on the page in ninths; e. g. 378^{3} means page 378 beginning in the third ninth of the page, i. e. about one third of the way down. Page numbers referring to descriptions of species are printed in black face type.

University of the State of New York

New York State Museum

PUBLICATIONS

Postage or express to places outside of New York State must be paid in addition to the price given. On 10 or more copies of any one publication 20% discount will be given, the buyer to pay transportation. Editions printed are only large enough to meet special claims and probable sales. When the sale copies are exhausted, the price for the few reserve copies is advanced to that charged by secondhand booksellers, in order to limit their distribution to cases of special need. Such prices are inclosed in [ ]. All publications are in paper covers, unless binding is specified.

Museum annual reports 1847–date. *All in print to 1892, 50c a volume, 75c in cloth; 1892-date, 75c, cloth.*

These reports are made up of the reports of the director, geologist, paleontologist, botanist and entomologist, and museum bulletins and memoirs, issued as advance sections of the reports.

Geologist's annual reports 1881-date. Rep'ts 1, 3-13, 17-date, O; 2, 14-16, Q.

The annual reports of the early natural history survey, 1837–41 are out of print.

Reports 1–4, 1881–84 were published only in separate form. Of the 5th report 4 pages were reprinted in the 39th museum report, and a supplement to the 6th report was included in the 40th museum report. The 7th and subsequent reports are included in the 41st and following museum reports, except that certain lithographic plates in the 11th report (1891) and 13th (1893) are omitted from the 45th and 47th museum reports.

Separate volumes of the following only are available.

Report	*Price*	*Report*	*Price*	*Report*	*Price*
12 (1892)	$.50	17	$.75	21	$.40
14	.75	18	.75	22	.40
15, 2v.	2	19	.40	23	*In press*
16	1	20	.50		

In 1898 the paleontologic work of the State was made distinct from the geologic and will hereafter be reported separately.

Paleontologist's annual reports 1899-date.

See fourth note under Geologist's annual reports.

Bound also with museum reports of which they form a part. Reports for 1899 and 1900 may be had for 20c each. Since 1901 these reports have been issued as bulletins.

Entomologist's annual reports on the injurious and other insects of the State of New York 1882-date.

Reports 3–19 bound also with museum reports 40–46, 48–57 of which they form a part. Since 1898 these reports have been issued as bulletins. Reports 3–4 are out of print, other reports with prices are:

Report	*Price*	*Report*	*Price*	*Report*	*Price*
1	$.50	9	$.25	15 (En 9)	$.15
2	.30	10	.35	16 (" 10)	.25
5	.25	11	.25	17 (" 14)	.30
6	.15	12	.25	18 (" 17)	.20
7	.20	13	.10	19 (" 21)	.15
8	.25	14 (En 5)	.20		

Reports 2, 8–12 may also be obtained bound separately in cloth at 25c in addition to the price given above.

Botanist's annual reports 1867-date.

Bound also with museum reports 21-date of which they form a part; the first botanist's report appeared in the 21st museum report and is numbered 21. Reports 21–24, 29, 31–41 were not published separately.

Separate reports 25–28, 30, 42-50 and 52 (Botany bulletin 3) are out of print. Report 51 may be had for 40c; 53 for 20c; 54 for 50c. Since the 55th these reports have been issued as bulletins.

Descriptions and illustrations of edible, poisonous and unwholesome fungi of New York have been published in volumes 1 and 3 of the 48th museum report and in volume 1 of the 49th, 51st, 52d, 54th and 55th reports. The descriptions and illustrations of edible and unwholesome species contained in the 49th, 51st and 52d reports have been revised and rearranged, and, combined with others more recently prepared constitute Museum memoir 4.

Museum bulletins 1887-date. O. *To advance subscribers, $2 a year or 50c a year for those of any one division: (1) geology, economic geology, mineralogy, general zoology, archeology and miscellaneous, (2) paleontology, (3) botany, (4) entomology.*

Bulletins are also found with the annual reports of the museum as follows:

Bulletin	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*	*Bulletin*	*Report*
G 1	48, v.1	Pa 1	54, v.1	En 7–9	53, v.1	Ar 3	52, v.1
2	51, v.1	2, 3	" v.3	10	54, v.2	4	54, v.1
3	52, v.1	4	" v.4	11	" v.3	5	" v.3
4	54, v.4	5, 6	55, v.1	12, 13	" v.4	6	55, v.1
5	56, v.1	7–9	56, v.2	14	55, v.1	7	56, v.4
Eg 5, 6	48, v.1	Z 3	53, v.1	15–18	56, v.3	Ms 1, 2	" v.4
7	50, v.1	4	54, v.1	Bo 3	52, v.1		
8	53, v.1	5–7	" v.3	4	53, v.1	Memoir	
9	54, v.2	8	55, v.1	5	55, v.1		
10	" v.3	9	56, v.3	6	56, v.4	2	49, v.3
11	56, v.1	En 3	48, v.1	Ar 1	50, v.1	3, 4	53, v.2
M 2	56, v.1	4–6	52, v.1	2	51, v.1		

The figures in parenthesis indicate the bulletin's number as a New York State Museum bulletin.

Geology. G1 (14) Kemp, J. F. Geology of Moriah and Westport Townships, Essex Co. N. Y., with notes on the iron mines. 38p. 7pl. 2 maps. Sep. 1895. *10c.*

G2 (19) Merrill, F: J. H. Guide to the Study of the Geological Collections of the New York State Museum. 162p. 119pl. map. Nov. 1898. [*50c*] *New edition in preparation.*

G3 (21) Kemp, J. F. Geology of the Lake Placid Region. 24p. 1pl. map. Sep. 1898. *5c.*

G4 (48) Woodworth, J. B. Pleistocene Geology of Nassau County and Borough of Queens. 58p. il. 9pl. map. Dec. 1901. *25c.*

G5 (56) Merrill, F: J. H. Description of the State Geologic Map of 1901. 42p. 2 maps, tab. Oct. 1902. *10c.*

G6 Cushing, H. P. Geology of the Vicinity of Little Falls, Herkimer Co. *In press.*

Woodworth, J. B. Pleistocene Geology of the Mooers Quadrangle. *In press.*

——— Ancient Water Levels of the Champlain and Hudson Valleys. *In press.*

Cushing, H. P. Crystalline Rocks of the Northeastern Adirondacks. *In press.*

Ogilvie, I. H. Geology of the Paradox Lake Quadrangle. *In press.*

Kemp, J. F. Crystalline Rocks of Warren and Washington Counties. *In preparation.*

Woodworth, J. B. Glacial Geology of New York. *In preparation.*

Economic geology. Eg1 (3) Smock, J: C. Building Stone in the State of New York. 152p. Mar. 1888. *Out of print.*

Eg2 (7) —— First Report on the Iron Mines and Iron Ore Districts in the State of New York. 6+70p. map. June 1889. *Out of print.*

Eg3 (10) ——Building Stone in New York. 210p. map, tab. Sep. 1890. *40c.*

Eg4 (11) Merrill, F: J. H. Salt and Gypsum Industries of New York. 92p. 12pl. 2 maps, 11 tab. Ap. 1893. *40c.*

Eg5 (12) Ries, Heinrich. Clay Industries of New York. 174p. 2pl. map. Mar. 1895. *30c.*

Eg6 (15) Merrill, F: J. H. Mineral Resources of New York. 224p. 2 maps. Sep. 1895. *50c.*

Eg7 (17) —— Road Materials and Road Building in New York. 52p. 14pl. 2 maps 34x45, 68x92 cm. Oct. 1897. *15c.*
Maps separate *10c each, two for 15c.*

Eg8 (30) Orton, Edward. Petroleum and Natural Gas in New York. 136p. il. 3 maps. Nov. 1899. *15c.*

Eg9 (35) Ries, Heinrich. Clays of New York; their Properties and Uses. 456p. 140pl. map. June 1900. *$1, cloth.*

Eg10 (44) —— Lime and Cement Industries of New York; Eckel, E. C. Chapters on the Cement Industry. 332p. 101pl. 2 maps. Dec. 1901. *85c, cloth.*

Eg11 (61) Dickinson, H. T. Quarries of Bluestone and other Sandstones in New York. 108p. 18pl. 2 maps. Mar. 1903. *35c.*

Rafter, G: W. Hydrology of New York State. *In press.*

Mineralogy. M1 (4) Nason, F. L. Some New York Minerals and their Localities. 20p. 1pl. Aug. 1888. *[10c]*

M2 (58) Whitlock, H. P. Guide to the Mineralogic Collections of the New York State Museum. 150p. il. 39pl. 11 models. Sep. 1902. *40c.*

M3 (70) —— New York Mineral Localities. 110p. Sep. 1903. *20c.*

Paleontology. Pa1 (34) Cumings, E. R. Lower Silurian System of Eastern Montgomery County; Prosser, C: S. Notes on the Stratigraphy of Mohawk Valley and Saratoga County, N. Y. 74p. 10pl. map. May 1900. *15c.*

Pa2 (39) Clarke, J: M.; Simpson, G: B. & Loomis, F: B. Paleontologic Papers 1. 72p. il. 16pl. Oct. 1900. *15c.*

Contents: Clarke, J: M. A Remarkable Occurrence of Orthoceras in the Oneonta Beds of the Chenango Valley, N. Y.
—— Paropsonema cryptophya; a Peculiar Echinoderm from the Intumescens-zone (Portage Beds) of Western New York.
—— Dictyonine Hexactinellid Sponges from the Upper Devonic of New York.
—— The Water Biscuit of Squaw Island, Canandaigua Lake, N. Y.
Simpson, G: B. Preliminary Descriptions of New Genera of Paleozoic Rugose Corals.
Loomis, F: B. Siluric Fungi from Western New York.

Pa3 (42) Ruedemann, Rudolf. Hudson River Beds near Albany and their Taxonomic Equivalents. 114p. 2pl. map. Ap. 1901. *25c.*

Pa4 (45) Grabau, A. W. Geology and Paleontology of Niagara Falls and Vicinity. 286p. il. 18pl. map. Ap. 1901. *65c; cloth, 90c.*

Pa5 (49) Ruedemann, Rudolf; Clarke, J: M. & Wood, Elvira. Paleontologic Papers 2. 240p. 13pl. Dec. 1901. *40c.*

Contents: Ruedemann, Rudolf. Trenton Conglomerate of Rysedorph Hill.
Clarke, J: M. Limestones of Central and Western New York Interbedded with Bituminous Shales of the Marcellus Stage.
Wood, Elvira. Marcellus Limestones of Lancaster, Erie Co. N. Y.
Clarke, J: M. New Agelacrinites
—— Value of Amnigenia as an Indicator of Fresh-water Deposits during the Devonic of New York, Ireland and the Rhineland.

Pa6 (52) Clarke, J: M. Report of the State Paleontologist 1901. 280p. il. 9pl. map, 1 tab. July 1902. *40c.*

Pa7 (63) —— Stratigraphy of Canandaigua and Naples Quadrangles. 78p. map. June 1904. *25c.*

Pa8 (65) —— Catalogue of Type Specimens of Paleozoic Fossils in the New York State Museum. 848p. May 1903. *$1.20, cloth.*

Pa9 (69) —— Report of the State Paleontologist 1902. 464p. 52pl. 8 maps. Nov. 1903. *$1, cloth.*

Pa10 (80) —— Report of the State Paleontologist 1903. *In press.*

Pa11 (81) Clark, J: M. & Luther, D.D. Watkins and Elmira Quadrangles. *In press.*

Pa12 (82) Clarke, J: M. & Luther, D. D. Geologic Map of the Tully Quadrangle. *In press.*

Grabau, A. W. Guide to the Geology and Paleontology of the Schoharie Region. *In preparation.*

Ruedemann, Rudolf. Cephalopoda of Beekmantown and Chazy Formations of Champlain Basin. *In preparation.*

Zoology. Z1 (1) Marshall, W: B. Preliminary List of New York Unionidae. 20p. Mar. 1892. *5c.*

Z2 (9) —— Beaks of Unionidae Inhabiting the Vicinity of Albany, N. Y. 24p. 1pl. Aug. 1890. *10c.*

Z3 (29) Miller, G. S. jr. Preliminary List of New York Mammals. 124p. Oct. 1899. *15c.*

Z4 (33) Farr, M. S. Check List of New York Birds. 224p. Ap. 1900. *25c.*

Z5 (38) Miller, G. S. jr. Key to the Land Mammals of Northeastern North America. 106p. Oct. 1900. *15c.*

Z6 (40) Simpson, G: B. Anatomy and Physiology of Polygyra albolabris and Limax maximus and Embryology of Limax maximus. 82p. 28pl. Oct. 1901. *25c.*

Z7 (43) Kellogg, J. L. Clam and Scallop Industries of New York. 36p. 2pl. map. Ap. 1901. *10c.*

Z8 (51) Eckel, E. C. & Paulmier, F. C. Catalogue of Reptiles and Batrachians of New York. 64p. il. 1pl. Ap. 1902. *15c.*

Eckel, E. C. Serpents of Northeastern United States.
Paulmier, F. C. Lizards, Tortoises and Batrachians of New York.

Z9 (60) Bean, T. H. Catalogue of the Fishes of New York. 784p. Feb. 1903. *$1, cloth.*

Z10 (71) Kellogg, J. L. Feeding Habits and Growth of Venus mercenaria. 30p. 4pl. Sep. 1903. *10c.*

Letson, Elizabeth J. Catalogue of New York Mollusca. *In press.*

Farr, M. S. Birds of New York. *In preparation.*

Paulmier, F. C. Higher Crustacea of New York City. *In preparation.*

Entomology. En1 (5) Lintner, J. A. White Grub of the May Beetle. 32p. il. Nov. 1888. *10c.*

En2 (6) —— Cut-worms. 36p. il. Nov. 1888. *10c.*

En3 (13) —— San José Scale and Some Destructive Insects of New York State. 54p. 7pl. Ap. 1895. *15c.*

En4 (20) Felt, E. P. Elm-leaf Beetle in New York State. 46p. il. 5pl. June 1898. *5c.*

See En15.

En5 (23) —— 14th Report of the State Entomologist 1898. 150p. il. 9pl. Dec. 1898. *20c.*

En6 (24) —— Memorial of the Life and Entomologic Work of J. A. Lintner Ph.D. State Entomologist 1874-98; Index to Entomologist's Reports 1-13. 316p. 1pl. Oct. 1899. *35c.*

Supplement to 14th report of the state entomologist.

En7 (26) —— Collection, Preservation and Distribution of New York Insects. 36p. il. Ap. 1899. *5c.*

En8 (27) —— Shade Tree Pests in New York State. 26p. il. 5pl. May 1899. *5c.*

En9 (31) —— 15th Report of the State Entomologist 1899. 128p. June 1900. *15c.*

En10 (36) —— 16th Report of the State Entomologist 1900. 118p. 16pl. Mar. 1901. *25c.*

En11 (37) —— Catalogue of Some of the More Important Injurious and Beneficial Insects of New York State. 54p. il. Sep. 1900. *10c.*

En12 (46) —— Scale Insects of Importance and a List of the Species in New York State. 94p. il. 15pl. June 1901. *25c.*

En13 (47) Needham, J. G. & Betten, Cornelius. Aquatic Insects in the Adirondacks. 234p. il. 36pl. Sep. 1901. *45c.*

En14 (53) Felt, E. P. 17th Report of the State Entomologist 1901. 232p. il. 6pl. Aug. 1902. *30c.*

En15 (57) —— Elm Leaf Beetle in New York State. 46p. il. 8pl. Aug. 1902. *15c.*

This is a revision of En4 containing the more essential facts observed since that was prepared.

En16 (59) —— Grapevine Root Worm. 40p. 6pl. Dec. 1902. *15c.*
See En19.

En17 (64) —— 18th Report of the State Entomologist 1902. 110p. 6pl. May 1903. *20c.*

En18 (68) Needham, J. G. *& others.* Aquatic Insects in New York. 322p. 52pl. Aug. 1903. *80c, cloth.*

En19 (72) Felt, E. P. Grapevine Root Worm. 58p. 13pl. Nov. 1903. *20c.*
This is a revision of En16 containing the more essential facts observed since that was prepared.

En20 (74) Felt, E. P. & Joutel, L. H. Monograph of the Genus Saperda. 88p. 14pl. June 1904. *25c.*

En21 (76) Felt, E. P. 19th Report of the State Entomologist 1903. 150p. 4pl. 1904. *15c.*

En22 (79) —— Mosquitos or Culicidae of New York. 164p. il. 57pl. Oct. 1904. *40c.*

Needham, J. G. *& others.* May Flies and Midges of New York. *In press.*

Botany. Bo1 (2) Peck, C: H. Contributions to the Botany of the State of New York. 66p. 2pl. May 1887. *Out of print.*

Bo2 (8) —— Boleti of the United States. 96p. Sep. 1889. [*50c*]

Bo3 (25) —— Report of the State Botanist 1898. 76p. 5pl. Oct. 1899. *Out of print.*

Bo4 (28) —— Plants of North Elba. 206p. map. June 1899. *20c.*

Bo5 (54) —— Report of the State Botanist 1901. 58p. 7pl. Nov. 1902. *40c.*

Bo6 (67) —— Report of the State Botanist 1902. 196p. 5pl. May 1903. *50c.*

Bo7 (75) —— Report of the State Botanist 1903. 70p. 4pl. 1904. *40c.*

Archeology. Ar1 (16) Beauchamp, W: M. Aboriginal Chipped Stone Implements of New York. 86p. 23pl. Oct. 1897. *25c.*

Ar2 (18) —— Polished Stone Articles used by the New York Aborigines. 104p. 35pl. Nov. 1897. *25c.*

Ar3 (22) —— Earthenware of the New York Aborigines. 78p. 33pl. Oct. 1898. *25c.*

Ar4 (32) —— Aboriginal Occupation of New York. 190p. 16pl. 2 maps. Mar. 1900. *30c.*

Ar5 (41) —— Wampum and Shell Articles used by New York Indians. 166p. 28pl. Mar. 1901. *30c.*

Ar6 (50) —— Horn and Bone Implements of the New York Indians. 112p. 43pl. Mar. 1902. *30c.*

Ar7 (55) —— Metallic Implements of the New York Indians. 94p. 38pl. June 1902. *25c.*

Ar8 (73) —— Metallic Ornaments of the New York Indians. 122p. 37pl. Dec. 1903. *30c.*

Ar9 (78) —— History of the New York Iroquois. *In press.*

—— Perch Lake Mounds. *In press.*

—— Aboriginal Use of Wood in New York. *In press.*

Miscellaneous. Ms1 (62) Merrill, F: J. H. Directory of Natural History Museums in United States and Canada. 236p. Ap. 1903. *30c.*

Ms2 (66) Ellis, Mary. Index to Publications of the New York State Natural History Survey and New York State Museum 1837-1902. 418p. June 1903. *75c, cloth.*

Museum memoirs 1889-date. Q.

1 Beecher, C: E. & Clarke, J: M. Development of some Silurian Brachiopoda. 96p. 8pl. Oct. 1889. *Out of print.*

2 Hall, James & Clarke, J: M. Paleozoic Reticulate Sponges. 350p. il. 70pl. 1898. *$1, cloth.*

3 Clarke, J: M. Oriskany Fauna of Becraft Mountain, Columbia Co. N. Y. 128p. 9pl. Oct. 1900. *80c.*

4 Peck, C: H. N. Y. Edible Fungi, 1895-99. 106p. 25pl. Nov. 1900. *75c.*
This includes revised descriptions and illustrations of fungi reported in the 49th, 51st and 52d reports of the state botanist.

5 Clarke, J: M. & Ruedemann, Rudolf. Guelph Formation and Fauna of New York State. 196p. 21pl. July 1903. *$1.50, cloth.*

6 —— Naples Fauna in Western New York. 268p. 26pl. map. *$2, cloth.*

7 Ruedemann, Rudolf. Graptolites of New York. Pt 1 Graptolites of the Lower Beds. *In press.*

Felt, E. P. Insects Affecting Park and Woodland Trees. *In press.*

Clarke, J: M. Early Devonic of Eastern New York. *In preparation.*

Natural history of New York. 30v. il. pl. maps. Q. Albany 1842-94.

DIVISION 1 ZOOLOGY. De Kay, James E. Zoology of New York; or, The New York Fauna; comprising detailed descriptions of all the animals hitherto observed within the State of New York with brief notices of those occasionally found near its borders, and accompanied by appropriate illustrations. 5v. il. pl. maps. sq. Q. Albany 1842-44. *Out of print.*
Historical introduction to the series by Gov. W: H. Seward. 178p.

v. 1 pt1 Mammalia. 13+146p. 33pl. 1842.
300 copies with hand-colored plates.

v. 2 pt2 Birds. 12+380p. 141pl. 1844.
Colored plates.

v. 3 pt3 Reptiles and Amphibia. 7+98p. pt4 Fishes. 15+415p. 1842.
pt3-4 bound together.

v. 4 Plates to accompany v. 3. Reptiles and Amphibia 23pl. Fishes 79pl. 1842.
300 copies with hand-colored plates.

v. 5 pt5 Mollusca. 4+271p. 40pl. pt6 Crustacea. 70p. 13pl. 1843-44.
Hand-colored plates: pt5-6 bound together.

DIVISION 2 BOTANY. Torrey, John. Flora of the State of New York; comprising full descriptions of all the indigenous and naturalized plants hitherto discovered in the State, with remarks on their economical and medical properties. 2v. il. pl. sq. Q. Albany 1843. *Out of print.*

v. 1 Flora of the State of New York. 12+484p. 72pl. 1843.
300 copies with hand-colored plates.

v. 2 Flora of the State of New York. 572p. 89pl. 1843.
300 copies with hand-colored plates.

DIVISION 3 MINERALOGY. Beck, Lewis C. Mineralogy of New York; comprising detailed descriptions of the minerals hitherto found in the State of New York, and notices of their uses in the arts and agriculture. il. pl. sq. Q. Albany 1842. *Out of print.*

v. 1 pt1 Economical Mineralogy. pt2 Descriptive Mineralogy. 24+536p. 1842.
8 plates additional to those printed as part of the text.

DIVISION 4 GEOLOGY. Mather, W: W.; Emmons, Ebenezer; Vanuxem, Lardner & Hall, James. Geology of New York. 4v. il. pl. sq. Q. Albany 1842-43. *Out of print.*

v. 1 pt1 Mather, W: W. First Geological District. 37+653p. 46pl. 1843.

v. 2 pt2 Emmons, Ebenezer. Second Geological District. 10+437p. 17pl. 1842.

v. 3 pt3 Vanuxem, Lardner. Third Geological District. 306p. 1842.

v. 4 pt4 Hall, James. Fourth Geological District. 22+683p. 19pl. map. 1843.

DIVISION 5 AGRICULTURE. Emmons, Ebenezer. Agriculture of New York; comprising an account of the classification, composition and distribution of the soils and rocks and the natural waters of the different geological formations, together with a condensed view of the meteorology and agricultural productions of the State. 5v. il. pl. sq. Q. Albany 1846-54. *Out of print.*

v. 1 Soils of the State, their Composition and Distribution. 11+371p. 21pl. 1846.

v. 2 Analysis of Soils, Plants, Cereals, etc. 8+343+46p. 42pl. 1849.
With hand-colored plates.

v. 3 Fruits, etc. 8+340p. 1851.

v. 4 Plates to accompany v. 3. 95pl. 1851.
Hand-colored.

v. 5 Insects Injurious to Agriculture. 8+272p. 50pl. 1854.
With hand-colored plates.

DIVISION 6 PALEONTOLOGY. Hall, James. Palaeontology of New York. 8v. il. pl. sq. Q. Albany 1847-94. *Bound in cloth.*

v. 1 Organic Remains of the Lower Division of the New York System. 23+338p. 99pl. 1847. *Out of print.*

v. 2 Organic Remains of Lower Middle Division of the New York System. 8+362p. 104pl. 1852. *Out of print.*

v. 3 Organic Remains of the Lower Helderberg Group and the Oriskany Sandstone. pt1, text. 12+532p. 1859. [*$3.50*]

—— pt2, 143pl. 1861. [*$2.50*]

v. 4 Fossil Brachiopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 11+1+428p. 99pl. 1867. *$2.50.*

v. 5 pt1 Lamellibranchiata 1. Monomyaria of the Upper Helderberg, Hamilton and Chemung Groups. 18+268p. 45pl. 1884. *$2.50.*

—— —— Lamellibranchiata 2. Dimyaria of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 62+293p. 51pl. 1885. *$2.50.*

—— pt2 Gasteropoda, Pteropoda and Cephalopoda of the Upper Helderberg, Hamilton, Portage and Chemung Groups. 2v. 1879. v. 1, text. 15+492p. v. 2, 120pl. *$2.50 for 2 v.*

v. 6 Corals and Bryozoa of the Lower and Upper Helderberg and Hamilton Groups. 24+298p. 67pl. 1887. *$2.50.*

v. 7 Trilobites and other Crustacea of the Oriskany, Upper Helderberg, Hamilton, Portage, Chemung and Catskill Groups. 64+236p. 46pl. 1888. Cont. supplement to v. 5, pt2. Pteropoda, Cephalopoda and Annelida. 42p. 18pl. 1888. *$2.50.*

v. 8 pt1 Introduction to the Study of the Genera of the Paleozoic Brachiopoda. 16+367p. 44pl. 1892. *$2.50.*

—— pt2 Paleozoic Brachiopoda. 16+394p. 84pl. 1894. *$2.50.*

Catalogue of the Cabinet of Natural History of the State of New York and of the Historical and Antiquarian Collection annexed thereto. 242p. O. 1853.

Handbooks 1893-date. 7½x12½ cm.
In quantities, 1 cent for each 16 pages or less. Single copies postpaid as below.

H5 New York State Museum. 52p. il. *4c.*
Outlines history and work of the museum with list of staff 1902.

H13 Paleontology. 12p. *2c.*
Brief outline of State Museum work in paleontology under heads: Definition; Relation to biology; Relation to stratigraphy; History of paleontology in New York.

H15 Guide to Excursions in the Fossiliferous Rocks of New York. 124p. *8c.*
Itineraries of 32 trips covering nearly the entire series of Paleozoic rocks, prepared specially for the use of teachers and students desiring to acquaint themselves more intimately with the classic rocks of this State.

H16 Entomology. 16p. *2c.*

H17 Economic Geology. 44p. *4c.*

H18 Insecticides and Fungicides. 20p. *3c.*

H19 Classification of New York Series of Geologic Formations. 32p. *3c.*

Maps. Merrill, F: J. H. Economic and Geologic Map of the State of New York; issued as part of Museum bulletin 15 and the 48th Museum Report, v. 1. 59x67 cm. 1894. Scale 14 miles to 1 inch. *Separate edition out of print.*

—— Geologic Map of New York. 1901. Scale 5 miles to 1 inch. *In atlas form $3; mounted on rollers $5. Lower Hudson sheet 60c.*
The lower Hudson sheet, geologically colored, comprises Rockland, Orange, Dutchess, Putnam, Westchester, New York, Richmond, Kings, Queens and Nassau counties, and parts of Sullivan, Ulster and Suffolk counties; also northeastern New Jersey and part of western Connecticut.

—— Map of New York showing the Surface Configuration and Water Sheds. 1901. Scale 12 miles to 1 inch. *15c.*

Clarke, J: M. & Luther, D. D. Geologic map of Canandaigua and Naples Quadrangles. 1904. *20c.*
Issued as part of Paleontology 7.